LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

LEVEL

0

INVENTORY

DTIC ACCESSION NUMBER

Corrective Action Plan for the Risk-Based . . .

DOCUMENT IDENTIFICATION

Mar 97

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

DISTRIBUTION STATEMENT

H A N D L E W I T H C A R E

ACCESSION FOR

NTIS GRA&I ☒
DTIC TRAC ☐
UNANNOUNCED ☐
JUSTIFICATION

BY

DISTRIBUTION/

AVAILABILITY CODES

DISTRIBUTION	AVAILABILITY AND/OR SPECIAL	
A-1		

DISTRIBUTION STAMP

DATE ACCESSIONED

DATE RETURNED

20010117 020

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

FINAL

Corrective Action Plan for the Risk-Based Remediation of the MOGAS Site

Myrtle Beach Air Force Base
South Carolina

Volume II of II

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas

and

Myrtle Beach Air Force Base
South Carolina

March 1997

DEFENSE TECHNICAL INFORMATION CENTER
REQUEST FOR SCIENTIFIC AND TECHNICAL REPORTS

Title AFCEE Collection

1. Report Availability *(Please check one box)*

☒ This report is available. *Complete sections 2a - 2f.*

☐ This report is not available. *Complete section 3.*

2a. Number of Copies Forwarded 1 each

2b. Forwarding Date July/2000

2c. Distribution Statement *(Please check ONE box)*

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly below. Technical documents MUST be assigned a distribution statement.

☒ DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited.

☐ DISTRIBUTION STATEMENT B: Distribution authorized to U.S. Government Agencies only.

☐ DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government Agencies and their contractors.

☐ DISTRIBUTION STATEMENT D: Distribution authorized to U.S. Department of Defense (DoD) and U.S DoD contractors only.

☐ DISTRIBUTION STATEMENT E: Distribution authorized to U.S. Department of Defense (DoD) components only.

☐ DISTRIBUTION STATEMENT F: Further dissemination only as directed by the controlling DoD office indicated below or by higher authority.

☐ DISTRIBUTION STATEMENT X: Distribution authorized to U.S. Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with DoD Directive 5230.25, Withholding of Unclassified Technical Data from Public Disclosure, 6 Nov 84.

2d. Reason For the Above Distribution Statement *(in accordance with DoD Directive 5230.24)*

2e. Controlling Office

HQ AFCEE

2f. Date of Distribution Statement Determination

15 Nov 2000

3. This report is NOT forwarded for the following reasons. *(Please check appropriate box)*

☐ It was previously forwarded to DTIC on .... *(date)* and the AD number is ....

☐ It will be published at a later date. Enter approximate date if known. ....

☐ In accordance with the provisions of DoD Directive 3200.12, the requested document is not supplied because:

Print or Type Name Laura Peña

Signature Laura Peña

Telephone 210-536-1431

(For DTIC Use Only)
AQ Number M01-04-0639

FINAL

CORRECTIVE ACTION PLAN
FOR THE RISK-BASED REMEDIATION OF THE MOGAS SITE

VOLUME II OF II

MYRTLE BEACH AIR FORCE BASE
SOUTH CAROLINA

March 1997

Prepared for

Air Force Center for Environmental Excellence
Brooks Air Force Base
San Antonio, Texas

and

Myrtle Beach Air Force Base, South Carolina

Prepared by
Parsons Engineering Science, Inc.
Denver, Colorado

022/725522/7.WW6

APPENDIX A

PERTINENT DATA FROM PREVIOUS SITE INVESTIGATIONS

APPENDIX A1

INSTALLATION RESTORATION PROGRAM

LONG TERM MONITORING STAGE 1

FINAL TECHNICAL REPORT

(ERM, JUNE 1990)

Figure 4-36
Peak Soil Gas Readings
MOGAS Storage Tank
Myrtle Beach AFB
South Carolina

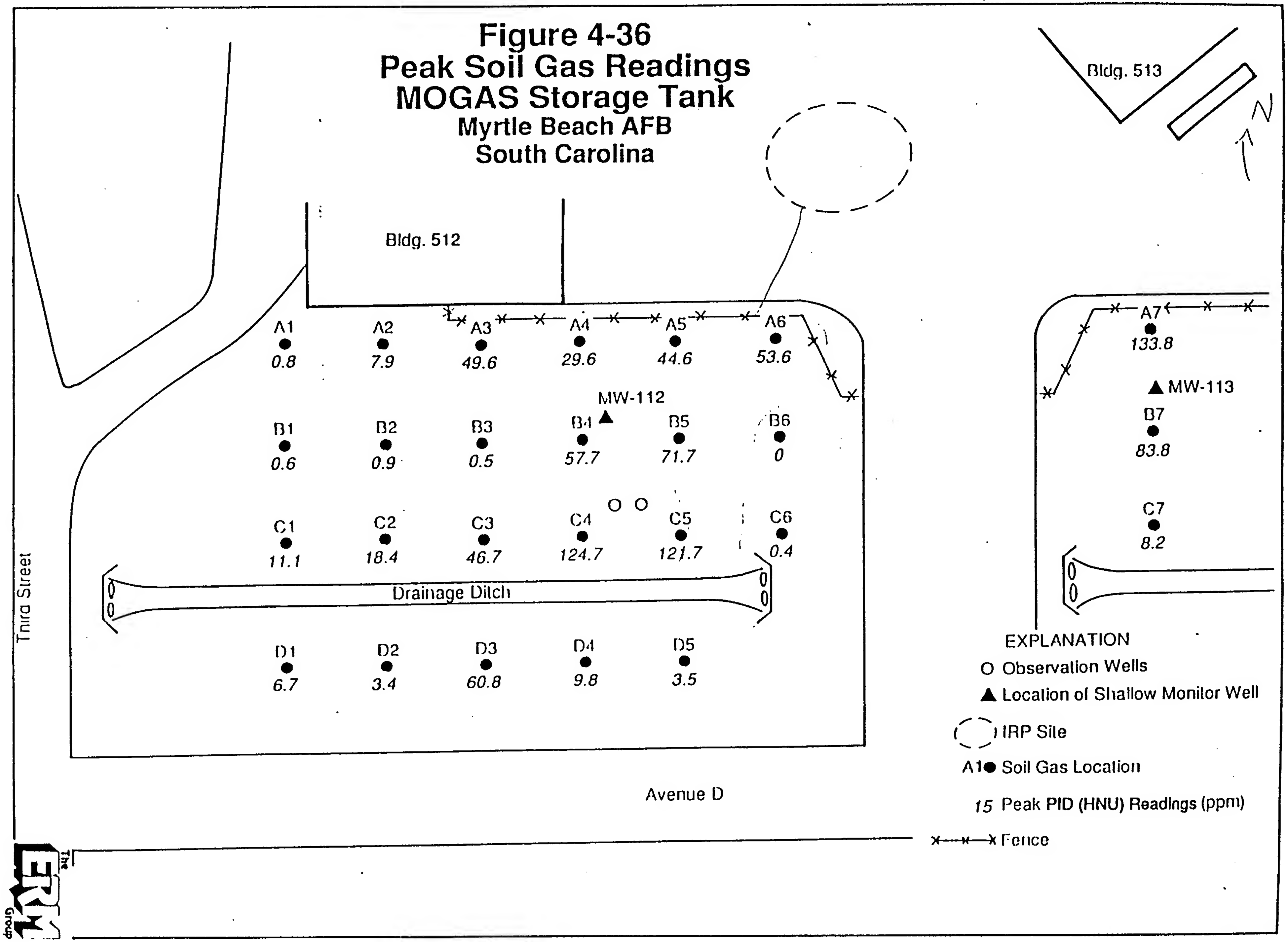


TABLE 4-22

SOIL GAS RESULTS
MOGAS STORAGE AREA
MYRTLE BEACH Air Force Base

Sample Designation	HNU Measurement (ppm) Peak	Stable
A1	0.8	0.7
A2	7.9	3.6
A3	49.6	18.6
A4	29.6	15.6
A5	44.6	42.6
A6	53.6	36.6
A7	133.8	93.8
B1	0.6	0.5
B2	0.9	0.5
B3	0.5	0.4
B4	57.7	29.7
B5	71.7	51.7
B6	0	0
B7	83.8	81.8
C1	11.1	7.8
C2	18.4	4.4
C3	46.7	40.7
C4	124.7	0
C5	121.7	0
C6	0.4	0.3
C7	8.2	7.4
D1	6.7	4.7
D2	3.4	3
D3	60.8	45.8
D4	9.8	8.4
D5	3.5	1.9

TABLE 4-23
MOGAS Storage Area
Analytical Results for Volatile Organic Compounds

Soil Boring Results For November 1988

Concentration (mg/kg)

Location:	111-B002	112-B007	113-B007	215-B006	216-B009	216-B011	Trip Blk	Trip Blk
ERM Traffic #:	13209	13212	13211	13213	13215	13214	13210	13218
Sample Depth:	0-2'	5-7'	5-7'	4-6'	7-9'	9-11'	-	-
Date Sampled:	11/16/88	11/16/88	11/16/88	11/17/88	11/17/88	11/17/88	11/16/88	11/17/88
Volatile Organic Compounds:								
Methylene Chloride							ND	ND
Chloroform		ND			ND	ND	8.7	6.6
Bromodichloromethane				ND			2.4	2.3
Tetrachloroethene								
Benzene	ND	14	ND		0.15			
Toluene		680			0.19	36	ND	ND
Ethylbenzene		330			0.3	6.7 J		
Xylene (total)		530			0.32	11 J		

J: This result should be considered a quantitative estimate.
The trip blanks correspond to the samples collected on that particular day.
Blank spaces indicate that the compound was not detected.

TABLE 4-24
MOGAS Storage Area
Analytical Results for Inorganics and Petroleum Hydrocarbons

Soil Boring Results For November 1988

Concentration (mg/kg)

Location:	111-B002	112-B007	113-B007	215-B006	216-B009	216-B011
ERM Traffic #:	13209	13212	13211	13213	13215	13214
Sample Depth:	0-2'	5-7'	5-7'	4-6'	7-9'	9-11'
Date Sampled:	11/16/88	11/16/88	11/16/88	11/17/88	11/17/88	11/17/88
Inorganic Compounds:						
Chromium, Total (P)	NA	NA	NA	NA	NA	NA
Lead, Total(F)						
Petroleum Hydrocarbons	290	30	6			110

(P): ICP (SW6010)
(F): Graphite Furnace (SW7421)
Blank spaces indicate that the compound was not detected.
NA: not analyzed

TABLE 4-25
MOGAS Storage Area
Analytical Results for Volatile Organic Compounds

Soil Cutting Results For November 1988

Concentration (mg/kg)

Location:	112-SC01	216-SC01
ERM Traffic #:	13216	13220
Date Sampled:	11/17/88	11/17/88
Volatile Organic Compounds:		
Methylene Chloride	8.6 B	.009 B
Acetone	3.1 B	.024 B
Chloroform		
2-Butanone	2.1 J	
Bromodichloromethane		
Tetrachloroethene		.002 J
Benzene		
Toluene	5.7	0.008
Ethylbenzene	2.6	0.006
Xylene (total)	12	0.025

B: analyte detected in the associated Method Blank.
J: This result should be considered a quantitative estimate.
Blank spaces indicate that the compound was not detected.

TABLE 4-26
MOGAS Storage Area
Analytical Results for Semivolatile Organic Compounds

Soil Cutting Results For November 1988

	Concentration (mg/kg)	
Location:	112-SC01	216-SC01
ERM Traffic #:	13216	13220
Date Sampled:	11/17/88	11/17/88
Semivolatile Organic Compounds:		
Naphthalene	5.1	
Acenaphthene	.06 J	
Fluorene	.075 J	
Pentachlorophenol		.58 J
Phenanthrene	.29 JB	.23 J
Anthracene	0.06 J	
Di-N-Butyl Phthalate	0.089 JB	.13 JB
Fluoranthene	0.25 JB	.78 B
Pyrene	.22 JB	1.5 B
Benzo(a)anthracene	.1 J	.29 J
Chrysene	.1 J	.28 J
bis(2-Ethylhexyl) Phthalate		
Benzo(b)fluoranthene	0.085	.27 J
Benzo(k)fluoranthene	.068 J	.3 J
Benzo(a)pyrene		.2 J
Indeno(1,2,3-cd)pyrene		.18 J
Benzo(g,h,i)perylene		.2 J
2-Methylnaphthalene	8.5	

B: Analyte detected in the associated Method Blank.
J: This result should be considered a quantitative estimate.
Blank spaces indicate that the compound was not detected.

TABLE 4-27
MOGAS Storage Area
Analytical Results for EP Toxicity Metals

Soil Cutting Results For November 1988

Concentration (mg/L)

Location:	112-SC01	216-SC01
ERM Traffic #:	13216	13220
Date Sampled:	11/17/88	11/17/88
EP TOX Metals:		
Silver		
Arsenic		
Barium		
Cadmium		
Chromium		
Mercury		
Lead		
Selenium		

Blank spaces indicate that the compound was not detected.

TABLE 4-28
MOGAS Storage Area
Analytical Results for Volatile Organic Compounds

Second Round Ground Water and Surface Water Sampling Results For December 1988

Concentration (ug/L)

Location:	MW-111	MW-112	MW-112R	MW-113	SW-5	SW-6	063-M002*	Ambient Blk	Trip Blk
ERM Traffic #:	13912	13913	13944	13914	13915	13916	13940	13942	13941
Date Sampled:	12/9/88	12/9/88	12/10/88	12/9/88	12/9/88	12/9/88	12/9/88	12/9/88	12/9/88
Volatile Organic Compounds:									
Chlorobenzene									
1,4-Dichlorobenzene		1900	5100						
1,3-Dichlorobenzene									
1,2-Dichlorobenzene									
Benzene		14000	7600	15		2	24		
Toluene		34000	16000						
Ethylbenzene		5100	3900				1.4		
Xylene (total)		7900	6000						
1,2-Dibromoethane									

The ambient and trip blanks correspond to all samples collected on December 9, 1988.
* 063-M002 is a duplicate of MW-113.
MW-112R: Resampling of well MW-112.
Blank spaces indicate that the compound was not detected.

TABLE 4-29
MOGAS Storage Area
Analytical Results for Inorganics, Petroleum Hydrocarbons, and TDS

Second Round Ground Water and Surface Water Sampling Results For December 1988

Concentration (mg/L)

Location:	MW-111	MW-112R	MW-113	SW-5	SW-6	063-M002*
ERM Traffic #:	13912	13944	13914	13915	13916	13940
Date Sampled:	12/9/88	12/10/88	12/9/88	12/9/88	12/9/88	12/9/88
Inorganic Compounds:						
Chromium, Total (P)	NA	NA	NA	NA	NA	NA
Lead, Total(F)	0.0464	NA	0.025	0.0099	0.0125	0.0282
Chromium, Dissolved (P)	NA	NA	NA	NA	NA	NA
Lead, Dissolved (F)	0.0192	NA		NA	NA	
Petroleum Hydrocarbons		NA		11	23	
Total Dissolved Solids	660	264	584	954	461	NA

(P): ICP (SW6010)
(F): Graphite Furnace (SW7421)
* 063-M002 is a duplicate of MW-113.
Blank spaces indicate that the compound was not detected.
NA: not analyzed
MW-112R: Resampling of well MW-112.

APPENDIX A2

SOIL GAS AND GROUND WATER SURVEY

MYRTLE BEACH AIR FORCE BASE

SOUTH CAROLINA

(TARGET ENVIRONMENTAL SERVICES, JULY 1993)

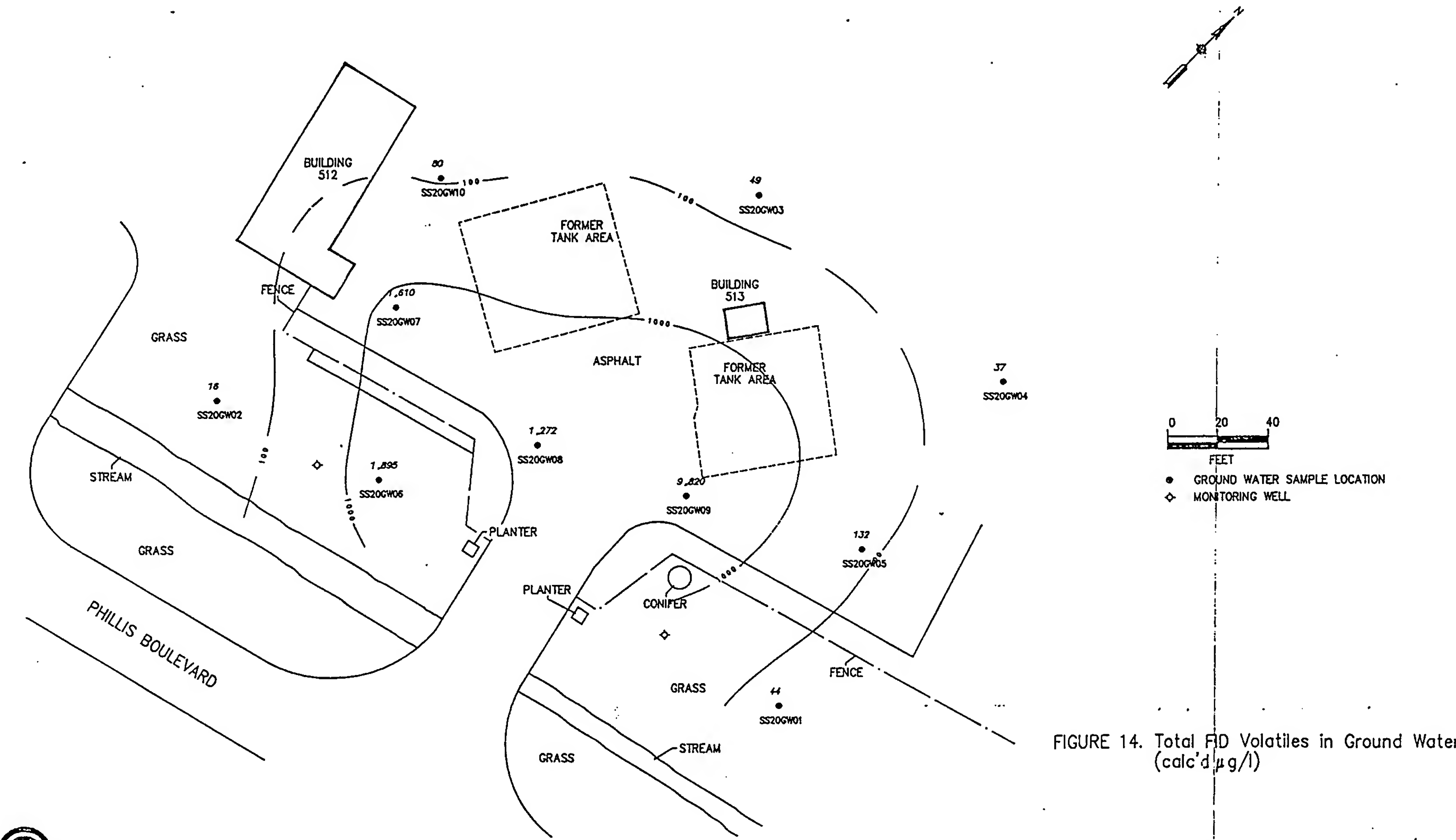


FIGURE 14. Total FID Volatiles in Ground Water (calc'd µg/l)

MOGAS SITE
MYRTLE BEACH AIR FORCE BASE
MYRTLE BEACH, SOUTH CAROLINA

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

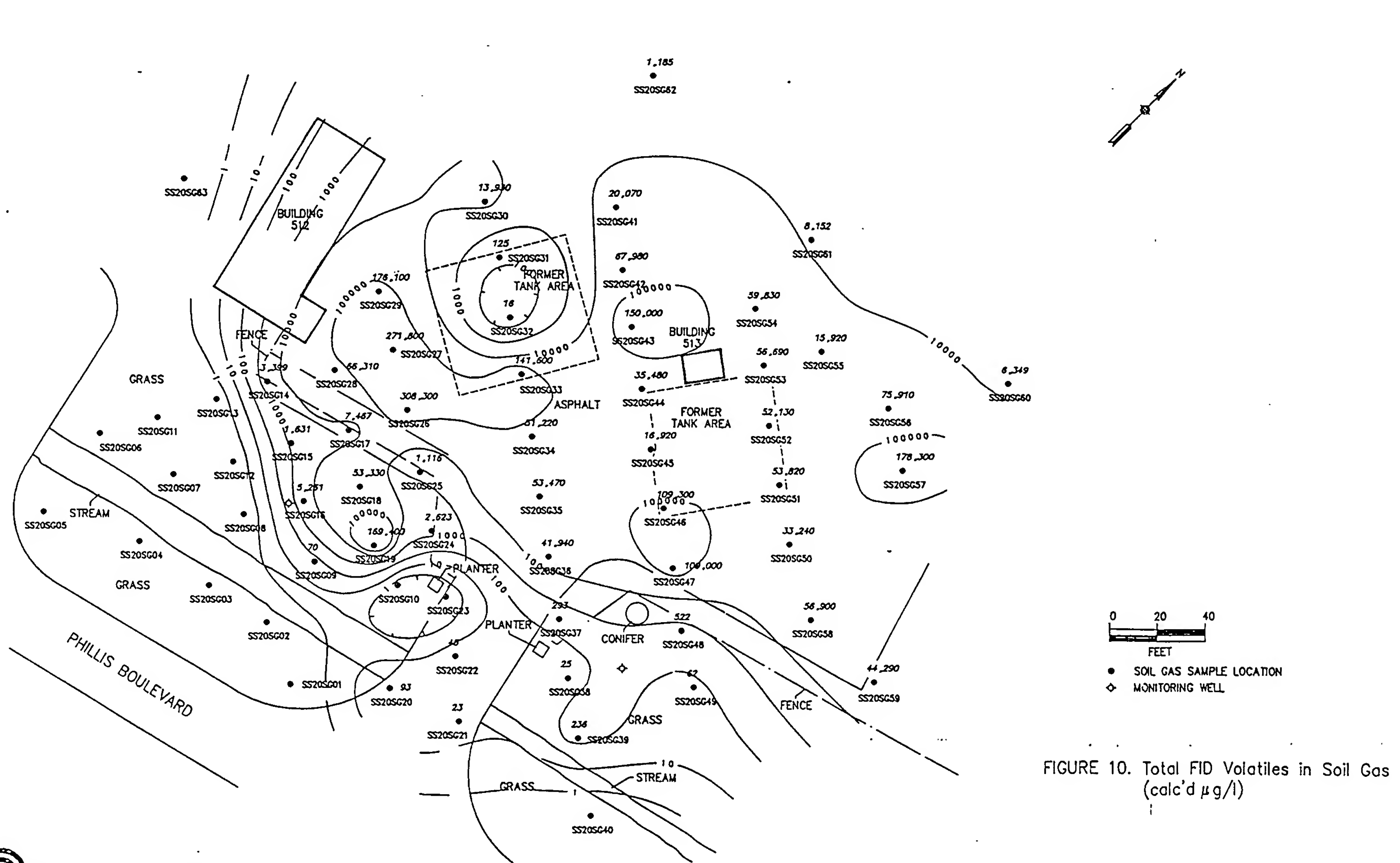


FIGURE 10. Total FID Volatiles in Soil Gas (calc'd μg/l)

MOGAS SITE
MYRTLE BEACH AIR FORCE BASE
MYRTLE BEACH, SOUTH CAROLINA

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

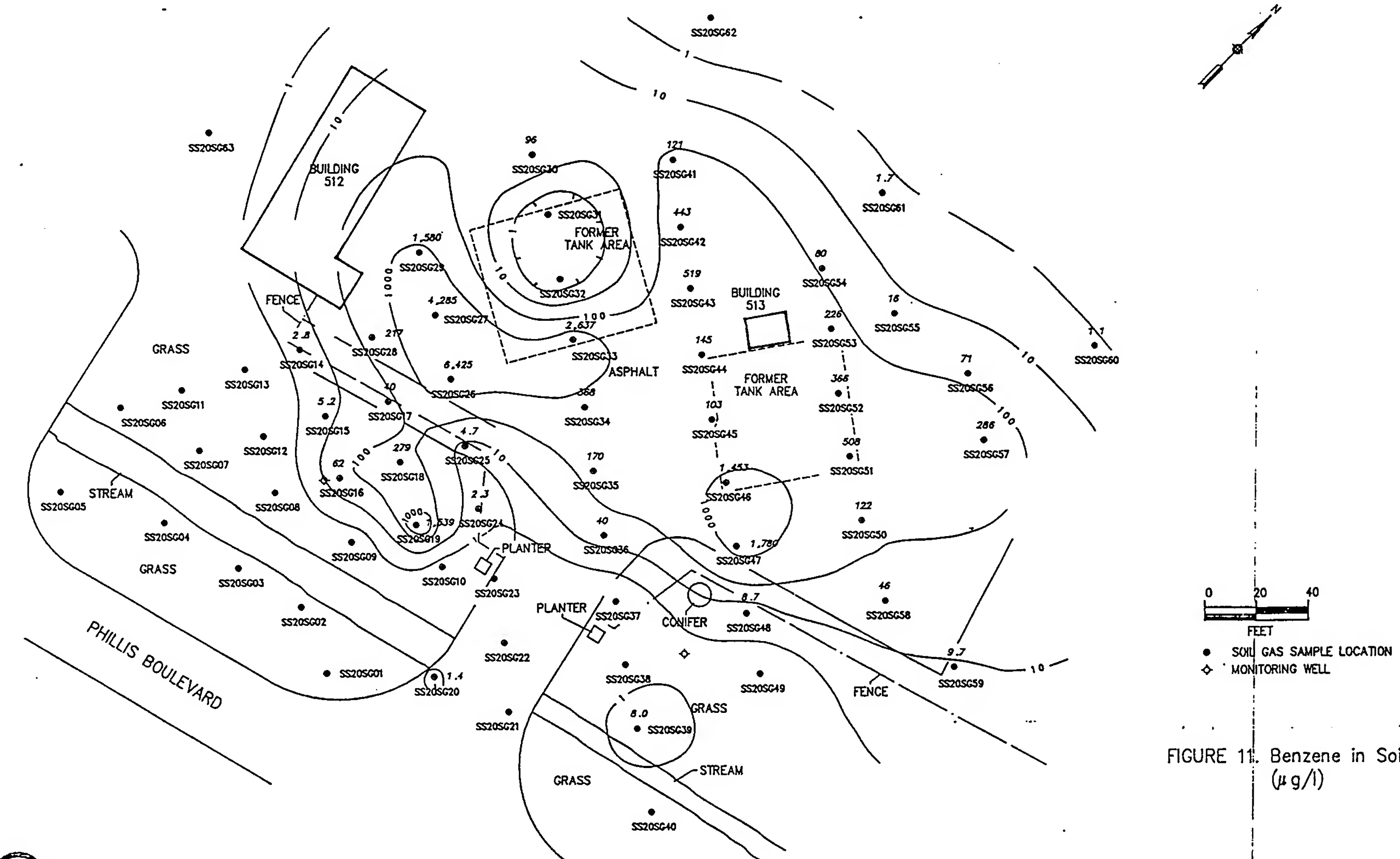


FIGURE 11. Benzene in Soil Gas (μg/l)

MOGAS SITE
MYRTLE BEACH AIR FORCE BASE
MYRTLE BEACH, SOUTH CAROLINA

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

APPENDIX A3

INSTALLATION RESTORATION PROGRAM

FIRST DRAFT MOGAS STORAGE AREA DATA SUMMARY REPORT

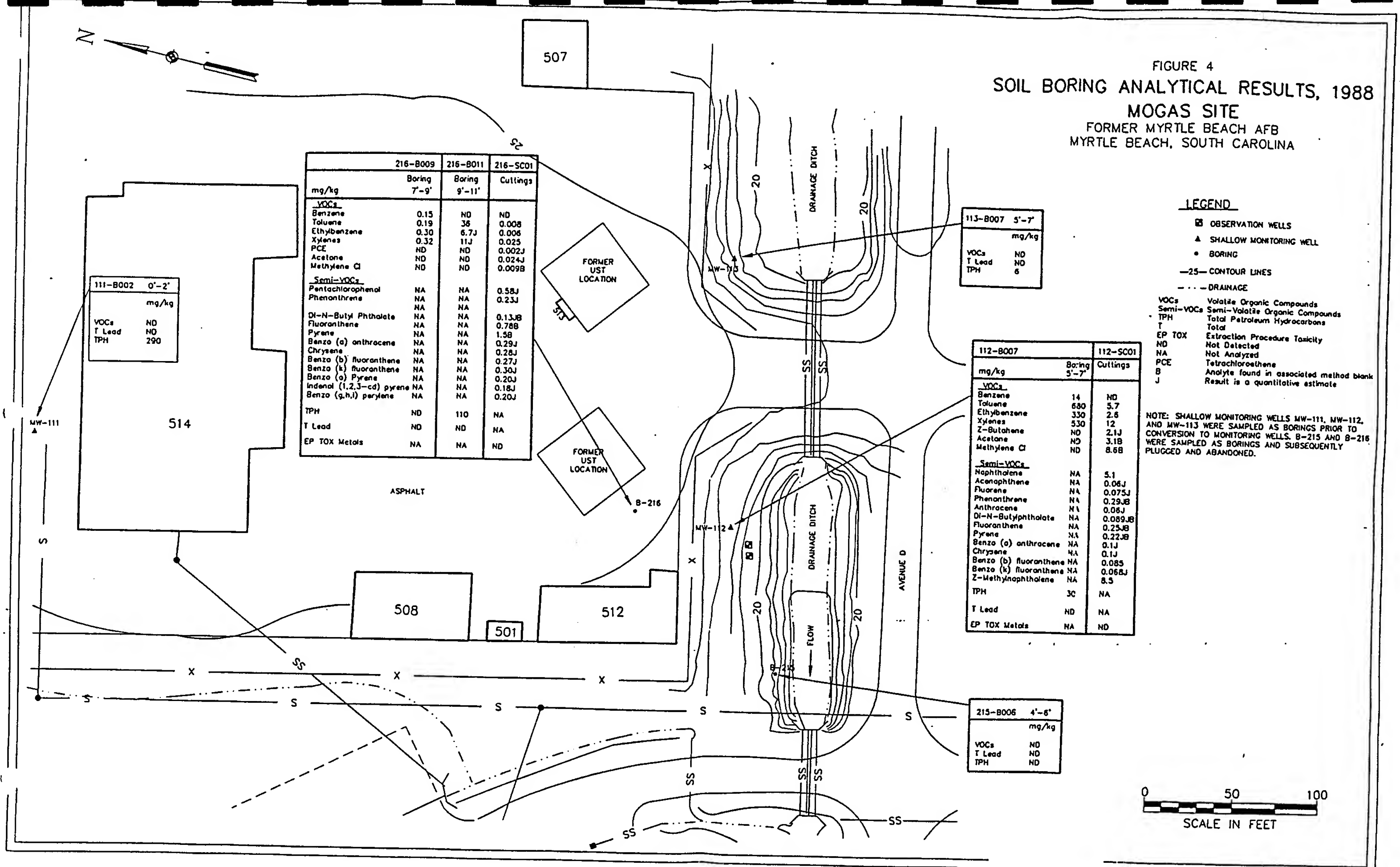
(LAW ENVIRONMENTAL, AUGUST 1993)

FIGURE 4

SOIL BORING ANALYTICAL RESULTS, 1988

MOGAS SITE

FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA



LEGEND

- ⊠ OBSERVATION WELLS
- ▲ SHALLOW MONITORING WELL
- • BORING
- —25— CONTOUR LINES
- — · · — DRAINAGE

VOCs	Volatile Organic Compounds
Semi-VOCs	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
T	Total
EP TOX	Extraction Procedure Toxicity
ND	Not Detected
NA	Not Analyzed
PCE	Tetrachloroethene
B	Analyte found in associated method blank
J	Result is a quantitative estimate

NOTE: SHALLOW MONITORING WELLS MW-111, MW-112, AND MW-113 WERE SAMPLED AS BORINGS PRIOR TO CONVERSION TO MONITORING WELLS. B-215 AND B-216 WERE SAMPLED AS BORINGS AND SUBSEQUENTLY PLUGGED AND ABANDONED.

mg/kg	216-B009 Boring 7'-9'	216-B011 Boring 9'-11'	216-SC01 Cuttings
VOCs			
Benzene	0.15	ND	ND
Toluene	0.19	36	0.008
Ethylbenzene	0.30	6.7J	0.006
Xylenes	0.32	11J	0.025
PCE	ND	ND	0.002J
Acetone	ND	ND	0.024J
Methylene Cl	ND	ND	0.009B
Semi-VOCs			
Pentachlorophenol	NA	NA	0.58J
Phenanthrene	NA	NA	0.23J
	NA	NA	
Di-N-Butyl Phthalate	NA	NA	0.13JB
Fluoranthene	NA	NA	0.78B
Pyrene	NA	NA	1.5B
Benzo (a) anthracene	NA	NA	0.29J
Chrysene	NA	NA	0.28J
Benzo (b) fluoranthene	NA	NA	0.27J
Benzo (k) fluoranthene	NA	NA	0.30J
Benzo (a) Pyrene	NA	NA	0.20J
Indenol (1,2,3-cd) pyrene	NA	NA	0.18J
Benzo (g,h,i) perylene	NA	NA	0.20J
TPH	ND	110	NA
T Lead	ND	ND	NA
EP TOX Metals	NA	NA	ND

mg/kg	112-B007 Boring 5'-7'	112-SC01 Cuttings
VOCs		
Benzene	14	ND
Toluene	680	5.7
Ethylbenzene	330	2.6
Xylenes	530	12
2-Butanone	ND	2.1J
Acetone	ND	3.1B
Methylene Cl	ND	8.6B
Semi-VOCs		
Naphthalene	NA	5.1
Acenaphthene	NA	0.06J
Fluorene	NA	0.075J
Phenanthrene	NA	0.29JB
Anthracene	NA	0.06J
Di-N-Butylphthalate	NA	0.089JB
Fluoranthene	NA	0.25JB
Pyrene	NA	0.22JB
Benzo (a) anthracene	NA	0.1J
Chrysene	NA	0.1J
Benzo (b) fluoranthene	NA	0.085
Benzo (k) fluoranthene	NA	0.068J
2-Methylnaphthalene	NA	8.5
TPH	30	NA
T Lead	ND	NA
EP TOX Metals	NA	ND

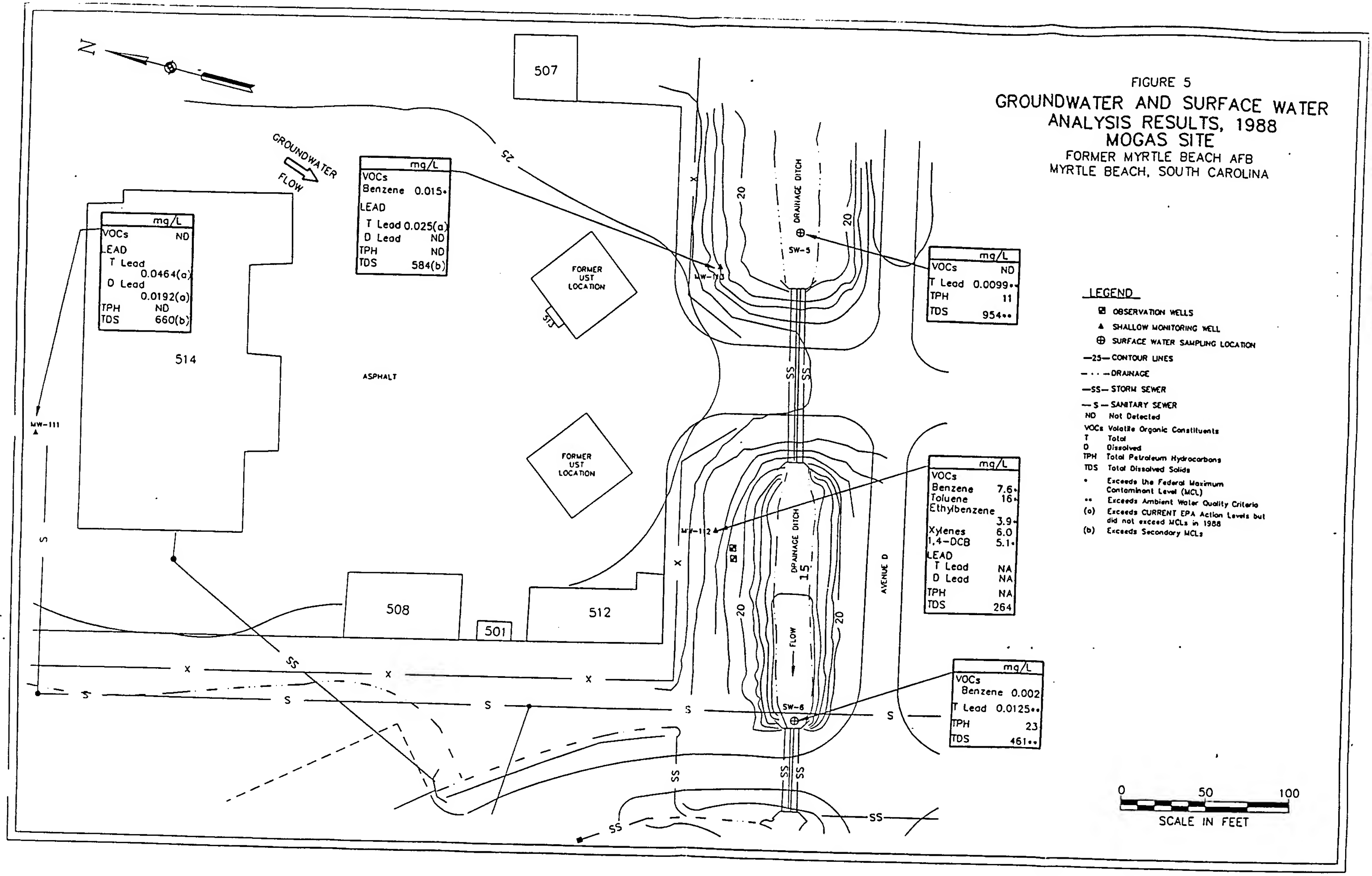
113-B007 5'-7'	mg/kg
VOCs	ND
T Lead	ND
TPH	6

111-B002 0'-2'	mg/kg
VOCs	ND
T Lead	ND
TPH	290

215-B006 4'-6'	mg/kg
VOCs	ND
T Lead	ND
TPH	ND

0 50 100
SCALE IN FEET

FILENAME: a:\MBAFB\MOGAS3.DWG

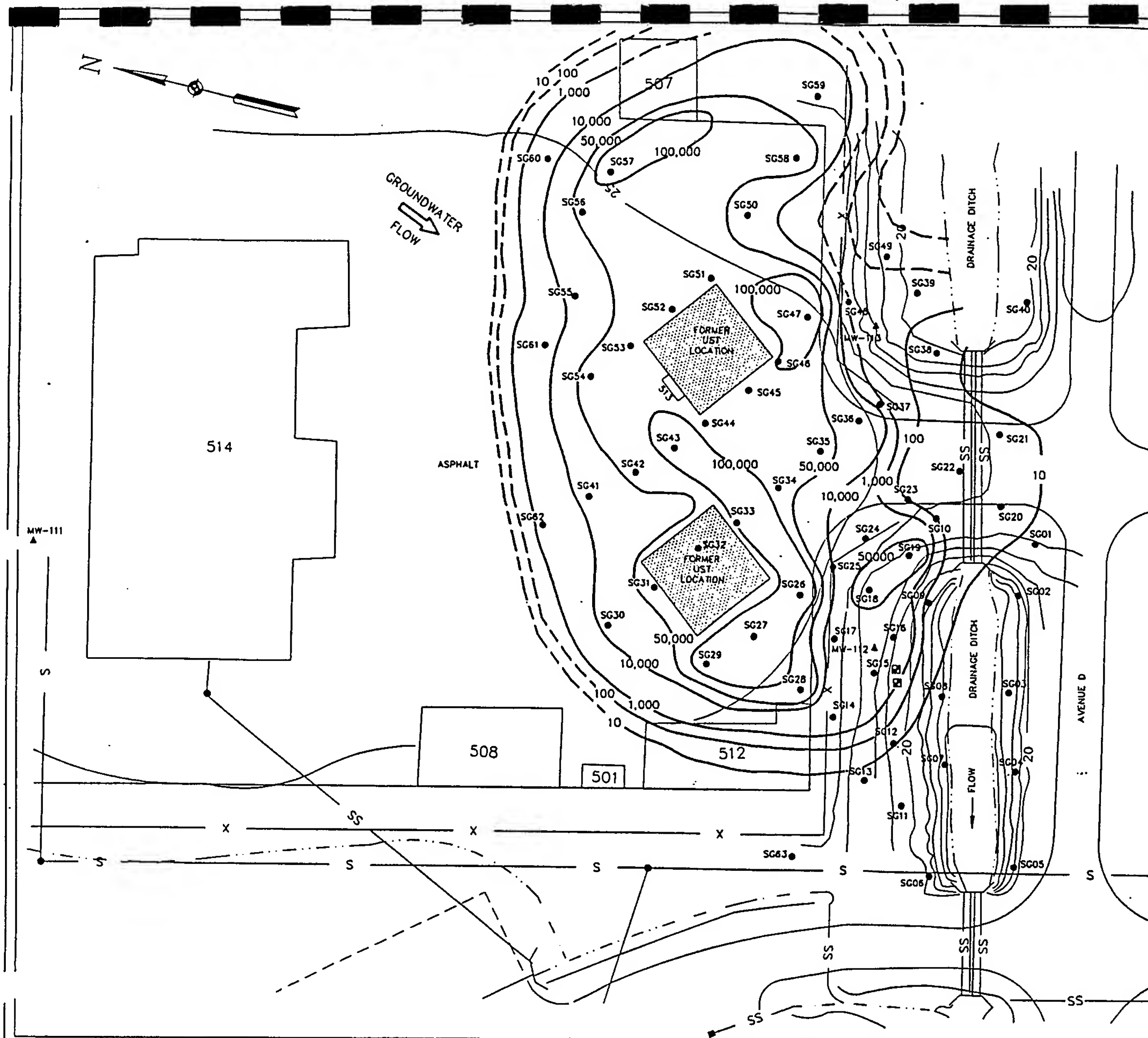


FILENAME: a:\MBAFB\MOGAS2.DWG

FIGURE 7

SOIL GAS TOTAL FID (ug/L) ISOPLETH MAP MOGAS SITE

FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA



LEGEND

- ● SOIL GAS POINTS
- ⊠ OBSERVATION WELLS
- ▲ SHALLOW MONITORING WELL
- —25— CONTOUR LINES
- — · · — DRAINAGE
- —SS— STORM SEWER
- — S — SANITARY SEWER
- ——— FID ISOPLETH

NOTE: SHADED AREA ILLUSTRATES SOIL EXCAVATION AND REPLACEMENT WITH CLEAN SOIL BY LAIDLAW DURING APRIL 1993.

CONCENTRATIONS (FID μg/L)

SG01	<10	SG21	23	SG41	20,070	SG61	8,152
SG02	<10	SG22	45	SG42	67,980	SG62	1,185
SG03	<10	SG23	<10	SG43	150,000	SG63	<10
SG04	<10	SG24	2,623	SG44	35,480		
SG05	<10	SG25	1,116	SG45	16,920		
SG06	<10	SG26	308,300	SG46	109,300		
SG07	<10	SG27	271,800	SG47	109,000		
SG08	<10	SG28	66,310	SG48	522		
SG09	70	SG29	176,100	SG49	62		
SG10	<10	SG30	13,930	SG50	33,240		
SG11	<10	SG31	125	SG51	53,820		
SG12	<10	SG32	16	SG52	52,130		
SG13	<10	SG33	141,600	SG53	56,690		
SG14	3,399	SG34	51,220	SG54	59,830		
SG15	1,631	SG35	53,470	SG55	15,920		
SG16	5,261	SG36	41,940	SG56	75,910		
SG17	7,467	SG37	293	SG57	178,300		
SG18	53,330	SG38	25	SG58	56,900		
SG19	169,400	SG39	236	SG59	44,290		
SG20	93	SG40	<10	SG60	6,349		

0 50 100
SCALE IN FEET

FILENAME: g:\MBAFB\MOGAS.DWG

TABLE 3

FIELD GROUND-WATER SCREEN RESULTS, June 1993
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

PARAMETER	METHOD	UNITS	SAMPLE NUMBER				
			SS20GW01	SS20GW02	SS20GW03	SS20GW04	SS20GW05
Benzene	602M	µg/L	2.2	<1.0	1.4	3.3	5.8
Ethylbenzene	602M	µg/L	<1.0	<1.0	<1.0	<1.0	1.8
Toluene	602M	µg/L	<1.0	1.9	4.8	1.7	17
Xylenes, total[a]	602M	µg/L	1.3	2.0	8.2	2.9	20
Total FID Volatiles[b]	602M	µg/L	44	16	49	37	132

PARAMETER	METHOD	UNITS	SAMPLE NUMBER				
			SS20GW06	SS20GW07	SS20GW08	SS20GW09	SS20GW10
Benzene	602M	µg/L	36	34	42	358	3.8
Ethylbenzene	602M	µg/L	40	28	15	84	<1.0
Toluene	602M	µg/L	323	221	149	792	6.9
Xylenes, total[a]	602M	µg/L	244	148	71	686	4.7
Total FID Volatiles[b]	602M	µg/L	1895	1610	1272	9820	80

(a) Total xylenes includes ortho, meta and para xylenes.
(b) FID = Flame Ionization Detector

Sample Collection Date: 6/29/93

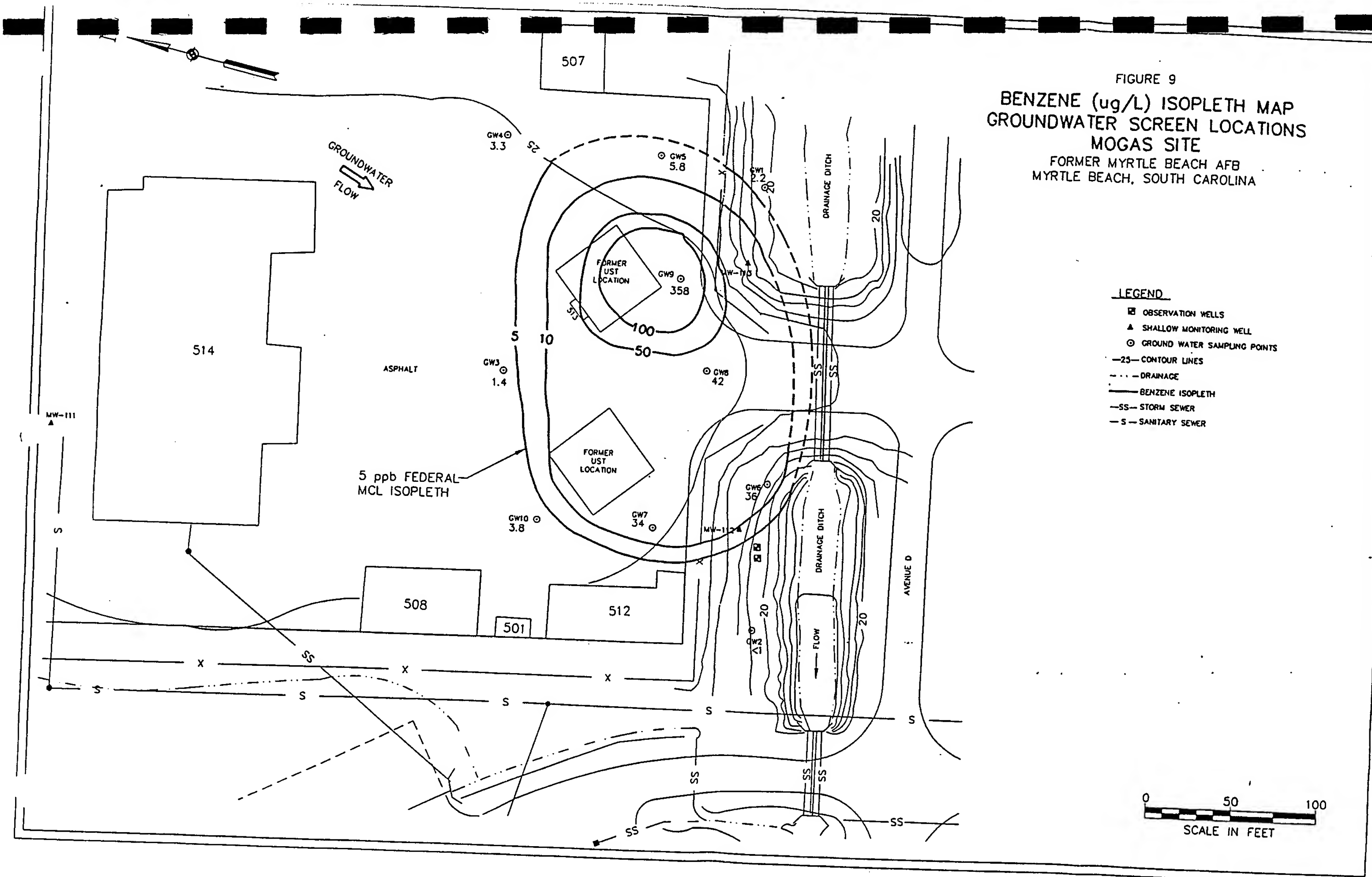


FIGURE 9

BENZENE (ug/L) ISOPLETH MAP
GROUNDWATER SCREEN LOCATIONS
MOGAS SITE

FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA

FILENAME: g:\MBAFB\BENZCONC.DWG

TABLE 4

GROUND-WATER SCREEN RESULTS, June 1993
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

PARAMETER	METHOD	UNITS	SAMPLE NUMBER		
			SS20GW02	SS20GW07	SS20GW09
Benzene	SW 8020	μg/L	1.2	150	590
Ethylbenzene	SW 8020	μg/L	<5.0	30	86
Toluene	SW 8020	μg/L	1.9	220	430
Xylenes	SW 8020	μg/L	1.8	82	280
Surrogates:					
fluorobenzene	SW 8020	%	106	106	106
4-chlorotoluene	SW 8020	%	109	108	112

Positive results listed only.
Sample Collection Date: 6/29/93

RESULTS OF SOILS FROM TANK EXCAVATIONS

LOCATION	B ppm	T ppm	E ppm	X ppm	BTEX ppm	TPH ppm
01G2NORTH	2.3	8.7	8.8	25.8	45.6	2800
02G2SOUTH	2.6	3.2	6.2	56	68	1860
03G3NORTH	2.3	10.6	1.7	65.3	79.9	2330
04G3SOUTH	<1	<1	<1	<1	<1	6
01G4EAST	1.8	12.8	10.2	39.3	64.1	2000
02G4WEST	<1	13.6	7.2	32.6	54.4	1900
03G5EAST	<1	6.5	4.4	17.4	29.3	82.5
04G5WEST	2	3.1	3.6	6.2	14.9	111

RESULTS OF SOILS FROM STOCKPILES

LOCATION	B ppm	T ppm	E ppm	X ppm	BTEX ppm	TPH ppm
G2G301	<1	<1	<1	<1	<5	2.3
G2G302	<1	4.4	2.3	48.9	56.6	1600
G2G303	<1	<1	<1	16.2	19.2	1110
G2G304	<1	<1	1.3	28	31.3	1320
G2G305	<1	<1	<1	<1	<1	2260
G2G306	<1	<1	<1	<1	<1	612
G2G307	<1	<1	<1	9.5	10	1050
G2G308	<1	<1	<1	<1	<1	16
G2G309	<1	<1	<1	4.9	7.9	748
G11112	<1	4	2.5	29.7	37.2	899

April 1993

APPENDIX A4

INSTALLATION RESTORATION PROGRAM

CORRECTIVE ACTION PLAN

(LAW ENVIRONMENTAL, JULY 1994)

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: / Sample Depth:	SS20SB01D 03/08/94 6–8'	SS20SB01E 03/08/94 8–10'	SS20SB02A 03/08/94 0–2'	SS20SB02C 03/08/94 4–6'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.054P	0.58P JD	0.045P	0.047P
ETHYLBENZENE	MG/KG	0.0005		0.066P	0.34P	<0.0025P	0.022P
M,P-XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.23P	1.4P JD	<0.005P	0.094P
TOLUENE	MG/KG	0.0005		0.18P	1.8P	0.0048P	0.056P
tert-BUTYL METHYL ETHER	MG/KG	0.005		0.11P	<0.5	<0.025P	<0.125P
Surrogates:							
4-CHLOROTOLUENE (79 – 124 % R)	%	1.0		103P	105P	88P	105P
FLUOROBENZENE (77 – 125 % R)	%	1.0		103P	98P	108P	100P
Dilution Factor:	--	--		* 50 / 5	** 200 / 100	5	25
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		5.1	12	<0.22	1.7
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		21	20	8	17

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Benzene, Toluene 50X, all other compounds 5X.
** – Benzene, Toluene 200X all other compounds 100X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

17 85.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	SS20SB03D 03/08/94 6-8'	SS20SB03E 03/08/94 8-10'	SS20SB04A 03/08/94 0-2'	SS20SB04D 03/08/94 6-8'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.28P	15P JD	0.0027P	0.015P
ETHYLBENZENE	MG/KG	0.0005		0.59P	130P JD	0.0018P	0.0042P
M,P-XYLENE (SUM OF ISOMERS)	MG/KG	0.001		2.1P	430P JD	0.011P	0.015P
TOLUENE	MG/KG	0.0005		2.2P JD	240P JD	0.0051P	0.015P
tert-BUTYL METHYL ETHER	MG/KG	0.005		<0.25P	<5.0P JD	<0.005P	<0.12P
Surrogates:							
4-CHLOROTOLUENE (79 - 124% R)	%	1.0		100P	115P	120P	105P
FLUOROBENZENE (77 - 125% R)	%	1.0		100P	95P	108P	100P
Dilution Factor:	--	--		* 1000 / 50	** 25000 / 10000	1	25
M8015/TPH - Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		140	39000 J	0.37	2.4
Dilution Factor:	--	--		50	5000	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		20	16	9	18

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Toluene 1000X, all other compounds 50X.
** – Toluene 25000X all other compounds 10000X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

35

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	SS20SB05D 03/08/94 6–8'	SS20SB05E 03/08/94 8–10'	SS20SB06B 03/08/94 2–4'	SS20SB06E 03/08/94 8–10'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.11P	3.3P JD	0.041P	0.051P
ETHYLBENZENE	MG/KG	0.0005		0.053P	21P JD	<0.0025P	<0.05P
M,P-XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.21P	90P JD	<0.005P	0.27P
TOLUENE	MG/KG	0.0005		0.34P	56P JD	0.012P	0.2P
tert-BUTYL METHYL ETHER	MG/KG	0.005		0.16P	<50P JD	<0.025P	<0.025P
Surrogates:							
4-CHLOROTOLUENE (79 – 124% R)	%	1.0		105P	103P	95P	104P
FLUOROBENZENE (77 – 125% R)	%	1.0		98P	100P	108P	100P
Dilution Factor:	--	--		50	* 500 / 10000	5	** 100 / 5
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		8.8	610	<1.1	210
Dilution Factor:	--	--		1	100	1	50
D2216/Soil Moisture:							
MOISTURE	%	--		15	28	11	19

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
* – Benzene 500X, all other compounds 10000X.
** – Benzene, Ethylbenzene, Toluene, Xylene 100X, all other compounds 5X.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	SS20SB07A 03/08/94 0–2'	SS20SB07E 03/08/94 8–10'	SS20SB08B 03/08/94 2–4'	Sample SS20SB08D 03/08/94 6–8'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.17P	0.048P	0.0035P	3.0P JD
ETHYLBENZENE	MG/KG	0.0005		0.5P	0.07P	<0.0005P	4.8P JD
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.17P	0.19P	<0.001P	23P JD
TOLUENE	MG/KG	0.0005		0.04P	0.02P	0.0048P	19P JD
tert–BUTYL METHYL ETHER	MG/KG	0.005		0.16P	<0.12P	<0.005P	<0.5P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		95P	106P	103P	168P
FLUOROBENZENE (77 – 125% R)	%	1.0		110P	103P	110P	125P
Dilution Factor:	--	--		50	* 25 / 5	** 5 / 1	* 2000 / 100
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		13	1.4	<1.1	2.3
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		6	19	10	7.0

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Benzene, Ethylbenzene, MTBE 25X, all other compounds 5X.
** – Benzene, Toluene 5X, all other compounds 1X.
* – Benzene, Ethylbenzene, Toluene, Xylene, 2000X all other compounds 100X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

E 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	Duplicate SS20SBDUP2 03/08/94 6–8'	Sample SS20SB09D 03/08/94 6–8'	Duplicate SS20SBDUP1 03/08/94 6–8'	SS20SB09E 03/08/94 8–10'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.13P J	0.086P	0.063P	1.6P JD
ETHYLBENZENE	MG/KG	0.0005		0.046P J	0.66P JD	0.11P J	11P JD
M,P-XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.21P J	2.6P JD	0.4P J	39P JD
TOLUENE	MG/KG	0.0005		0.24P J	2.1P JD	0.4P J	25P JD
tert-BUTYL METHYL ETHER	MG/KG	0.005		<0.005P	<0.25P	<0.25P	<1.0P JD
Surrogates:							
4-CHLOROTOLUENE (79 – 124% R)	%	1.0		106P	113P	105P	105P
FLUOROBENZENE (77 – 125% R)	%	1.0		99P	98P	105P	100P
Dilution Factor:	--	--		*** 25 / 1	** 250 / 50	50	* 5000 / 200
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		4.9	<1.1	<1.1	770
Dilution Factor:	--	--		1	1	1	200
D2216/Soil Moisture:							
MOISTURE	%	--		13	15	14	19

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column. Results are quantitated as gasoline or diesel but may be identified as another fuel.
(c) – Primary result.
-- Not Applicable.
P – Primary result.
TPH – Total Petroleum Hydrocarbons.
* – Ethylbenzene, Toluene, Xylene 5000X, all other compounds 200X.
** – Toluene 250X, all other compounds 50X.
*** – Benzene, Ethylbenzene, Toluene, Xylene 25X, all other compounds 1X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	SS20SB10C 03/08/94 4–6'	SS20SB10D 03/08/94 6–8'	SS20SB11D 03/08/94 6–8'	SS20SB11E 03/08/94 8–10'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.46P	0.48P	0.063P	1.3P JD
ETHYLBENZENE	MG/KG	0.0005		0.053P	0.073P	0.072P	40P JD
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.24P	0.37P	0.3P	140P JD
TOLUENE	MG/KG	0.0005		0.42P	0.31P	0.35P	43P JD
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.13P	<0.13P	<0.013P	<10P JD
Surrogates:							
4–CHLOROTOLUENE (79 – 124 % R)	%	1.0		105P	108P	120P	112P
FLUOROBENZENE (77 – 125 % R)	%	1.0		98P	98P	100P	98P
Dilution Factor:	--	--		25	* 50 / 25	** 2.5 / 100	*** 5000 / 2000
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		6.2	<1.2	5.2	400
Dilution Factor:	--	--		1	1	1	200
D2216/Soil Moisture:							
MOISTURE	%	--		19	15	21	16

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Toluene 50X, all other compounds 25X.
** – tert–Butyl, Methyl–ether 2.5X, all other compounds 100X.
*** – Toluene, Xylene 5000C all other compounds 2000X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	SS20SB12D 03/08/94 6–8'	SS20SB12E 03/08/94 8–10'	SS20SB13B 03/09/94 2–4'	SS20SB13E 03/09/94 8–10'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.24P	63P JD	0.0067P	0.0036P
ETHYLBENZENE	MG/KG	0.0005		0.052P	79P JD	0.037P	0.011P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.27P	420P JD	0.12P	0.0099P
TOLUENE	MG/KG	0.0005		0.21P	350P JD	0.0062P	0.003P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.025P	<25P JD	<0.025P	<0.005P
Surrogates:							
4–CHLOROTOLUENE (79 – 124 % R)	%	1.0		120P	107P	105P	108P
FLUOROBENZENE (77 – 125 % R)	%	1.0		103P	100P	105P	108P
Dilution Factor:	--	--		* 100 / 5	** 25000 / 5000	5	1
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		5.6	9200	<1.1	<1.2
Dilution Factor:	--	--		1	1000	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		17	14	9.0	13

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- – Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Benzene, Toluene 100X, all other compounds 5X.
** – Toluene, xylene 25000X, all other compounds 5000X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	Sample SS20SB14D 03/09/94 6–8'	Duplicate SS20SBDUP3 03/09/94 6–8'	SS20SB14E 03/09/94 8–10'	SS20SB15C 03/09/94 4–6'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.55P	0.33P	30P JD	0.0013P
ETHYLBENZENE	MG/KG	0.0005		0.062P	0.063P	51P JD	0.0029P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.29P	0.3P	330P JD	0.0066P
TOLUENE	MG/KG	0.0005		0.54P	0.4P	200P JD	0.0039P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.5P	<0.5P	<13P JD	<0.005P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		103P	103P	107P	98P
FLUOROBENZENE (77 – 125% R)	%	1.0		100P	98P	105P	103P
Dilution Factor:	--	--		100	100	* 25000 / 2500	** 5
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		3.0	8.0	860	<1.0
Dilution Factor:	--	--		1	1	200	1
D2216/Soil Moisture:							
MOISTURE	%	--		17	16	15	10

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- – Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Toluene, Xylene 25000X, all other compounds 2500X.
** – Benzene.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

LE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: / Sample Depth:	SS20SB15E 03/09/94 8–10'	SS20SB16B 03/09/94 2–4'	SS20SB16D 03/09/94 6–8'	SS20SB17D 03/09/94 6–8'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.025P	0.62P	0.28P	0.037P
ETHYLBENZENE	MG/KG	0.0005		0.14P	0.65P	0.054P	0.035P
M,P-XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.24P	3.0P JD	0.29P	0.035P
TOLUENE	MG/KG	0.0005		0.074P	2.8P JD	0.42P	0.0049P
tert-BUTYL METHYL ETHER	MG/KG	0.005		<0.13P	<0.25P	<0.25P	<0.025P
Surrogates:							
4-CHLOROTOLUENE (79 – 124% R)	%	1.0		105P	120P	105P	110P
FLUOROBENZENE (77 – 125% R)	%	1.0		100P	98P	103P	98P
Dilution Factor:	--	--		25	* 500 / 50	50	5
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.3	2.6	5.8	2.2
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		18	10	17	17

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
* – Toluene, Xylene 500X, all other compounds 50X.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: / Sample Depth:	SS20SB17E 03/09/94 8–10'	SS20SB18C 03/09/94 4–6'	SS20SB18D 03/09/94 6–8'	SS20SB19B 03/09/94 2–4'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.007P	0.2P	0.2P	0.021P
ETHYLBENZENE	MG/KG	0.0005		0.0013P	0.037P	0.044P	0.05P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.0013P	0.12P	0.14P	0.17P
TOLUENE	MG/KG	0.0005		0.00057P	0.21P	0.22P	0.029P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.005P	<0.25P	<0.25P	<0.025P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		105P	105P	105P	100P
FLUOROBENZENE (77 – 125% R)	%	1.0		100P	108P	113P	103P
Dilution Factor:	--	--		1	50	50	5
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.2	1.2	2.1	<1.1
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		14	19	18	9.0

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

43

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample: Sample Date: Sample Depth:	SS20SB19E 03/09/94 8–10'	SS20SB20A 03/09/94 0–2'	SS20SB20D 03/09/94 6–8'	SS20SB21B 03/10/94 2–4'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.067P	0.0066P	0.085P	1.2P JD
ETHYLBENZENE	MG/KG	0.0005		0.007P	0.0033P	0.023P	1.3P JD
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.032P	0.0086P	0.074P	2.9P JD
TOLUENE	MG/KG	0.0005		0.0073P	0.011P	0.082P	0.45P JD
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.025P	<0.025P	<0.13P	<1.0P JD
Surrogates:							
4–CHLOROTOLUENE (79 – 124 % R)	%	1.0		90P	98P	105P	118P
FLUOROBENZENE (77 – 125 % R)	%	1.0		115P	103P	100P	100P
Dilution Factor:	--	--		5	5	25	200
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.1	<1.0	1.5	1.1
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		18	8.0	23	13

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: / Sample Depth:	Duplicate SS20SBDUP5 03/10/94 2-4'	SS20SB21D 03/10/94 6-8'	SS20SB22A 03/11/94 0-2'	SS20SB22C 03/11/94 4-6'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.15P J	0.35P	<0.0005P	<0.0005P
ETHYLBENZENE	MG/KG	0.0005		0.2P J	1.2P	0.00051P JH	<0.0005P
M,P-XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.72P J	6.0P	0.002P	<0.001P
TOLUENE	MG/KG	0.0005		0.43P J	4.2P	0.0056P JH	<0.0005P
tert-BUTYL METHYL ETHER	MG/KG	0.005		<0.25P	0.5P	<0.005P	<0.005P
Surrogates:							
4-CHLOROTOLUENE (79 - 124 % R)	%	1.0		108P	115P	90P	123P
FLUOROBENZENE (77 - 125 % R)	%	1.0		95P	95P	128P	100P
Dilution Factor:	--	--		50	100	1	1
M8015/TPH - Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.0	2.4	<1.1	<1.1
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		9.0	12	15	11

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

45

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	Sample SS20SB23B 03/10/94 2–4'	Duplicate SS20SBDUP4 03/10/94 2–4'	SS20SB23D 03/10/94 6–8'	Background SS20SB24B 03/11/94 2–4'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		<0.0005P	0.0011P	0.00053P	0.00086P
ETHYLBENZENE	MG/KG	0.0005		0.00075P	<0.0005P	<0.0005P	0.0027P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.0033P	0.0061P	0.0014P	0.016P J
TOLUENE	MG/KG	0.0005		0.01P	0.016P	0.0021P	0.026P J
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.005P	<0.005P	<0.005P	<0.005P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		90P	93P	100P	102P
FLUOROBENZENE (77 – 125% R)	%	1.0		118P	123P	108P	103P
Dilution Factor:	--	--		1	1	1	* 5 / 1
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.0	<1.0	<1.3	<1.0
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		12	12	28	9.0

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- – Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.
* – Toluene 5X, all other compounds 1X.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	Duplicate SS20SBDUP6 03/11/94 2–4'	Background SS20SB24D 03/11/94 6–8'	SS20SB25B 03/10/94 2–4'	SS20SB25D 03/10/94 6–8'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.00075P	<0.0005P	0.007P	0.09P
ETHYLBENZENE	MG/KG	0.0005		0.0017P	0.0017P	0.03P	0.03P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.0089P J	0.003P	0.063P	0.064P
TOLUENE	MG/KG	0.0005		0.006P J	0.0022P	0.054P	0.091P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.005P	<0.005P	<0.025P	<0.25P
Surrogates:							
4–CHLOROTOLUENE (79 – 124 % R)	%	1.0		108P	100P	100P	103P
FLUOROBENZENE (77 – 125 % R)	%	1.0		113P	108P	105P	95P
Dilution Factor:	--	--		1	1	5	50
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.0	<1.2	3.5	<1.4
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		6.0	23	9.0	37

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- – Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: Sample Depth:	SS20SB26B 03/24/94 2–4'	SS20SB26C 03/24/94 4–6'	SS20SB27B 03/10/94 2–4'	SS20SB27C 03/10/94 4–6'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		0.0013P	<0.0025P	<0.0005P	0.014P
ETHYLBENZENE	MG/KG	0.0005		0.0015P	<0.0025P	0.0011P	0.021P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.0043P	0.56P JH	0.0034P	0.047P
TOLUENE	MG/KG	0.0005		0.0021P	<0.0025P	0.00086P	0.0048P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.005P	<0.025P	<0.005P	<0.025P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		115P	350P	100P	105P
FLUOROBENZENE (77 – 125% R)	%	1.0		100P	113P	105P	100P
Dilution Factor:	--	--		1	5	1	5
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.1	<1.1	2.3	<1.0
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		17	16	7.0	16

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JH – Estimated quantitation; possibly biased high or false positive based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: / Sample Depth:	SS20SB28A 03/24/94 0–2'	SS20SB28B 03/24/94 2–4'	SS20SB29A 03/10/94 0–2'	SS20SB29C 03/10/94 4–6'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		<0.0025P	<0.0005P	<0.0005P	0.00075P
ETHYLBENZENE	MG/KG	0.0005		0.0093P	0.0027P	<0.0005P	<0.0005P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.027P	0.0021P	<0.001P	0.0013P
TOLUENE	MG/KG	0.0005		0.0063P	0.0012P	<0.0005P	0.0012P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.025P	<0.005P	<0.005P	<0.005P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		123P	123P	88P	98P
FLUOROBENZENE (77 – 125% R)	%	1.0		100P	98P	100P	105P
Dilution Factor:	--	--		5	1	1	1
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.1	<1.1	<1.1	<1.3
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		5.0	13	12	22

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH– Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 5

SOIL SAMPLES ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date: / Sample Depth:	SS20SB30A 03/24/94 0–2'	SS20SB30D 03/24/94 6–8'	SS20SB31B 03/24/94 2–4'	SS20SB31C 03/24/94 4–6'
SW8020/Aromatic Volatiles (b):							
BENZENE	MG/KG	0.0005		<0.0005P	0.0011P	<0.0005P	<0.0005P
ETHYLBENZENE	MG/KG	0.0005		<0.0005P	0.0022P	<0.0005P	<0.0005P
M,P–XYLENE (SUM OF ISOMERS)	MG/KG	0.001		0.0023P	0.0056P	0.0013P	<0.001P
TOLUENE	MG/KG	0.0005		0.00097P	0.0027P	0.0056P	0.0021P
tert–BUTYL METHYL ETHER	MG/KG	0.005		<0.005P	<0.005P	<0.005P	<0.005P
Surrogates:							
4–CHLOROTOLUENE (79 – 124% R)	%	1.0		115P	100P	115P	110P
FLUOROBENZENE (77 – 125% R)	%	1.0		100P	105P	108P	100P
Dilution Factor:	--	--		1	1	1	1
M8015/TPH – Volatiles (c):							
GASOLINE COMPONENTS	MG/KG	1.0		<1.0	<1.1	<1.0	<1.0
Dilution Factor:	--	--		1	1	1	1
D2216/Soil Moisture:							
MOISTURE	%	--		6.0	13	8.0	9.0

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary due to moisture content, volume, and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
(c) – Results are quantitated as gasoline or diesel but may be identified as another fuel.
P – Primary result.
-- Not Applicable.
TPH – Total Petroleum Hydrocarbons.
J – Estimated quantitation based on QC data.
JD – Estimated quantitation based on dilution.

TABLE 7

SURFACE WATER ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date:	Upstream SS20SW01 03/25/94	SS20SW02 03/25/94	SS20SW03 03/25/94
SW8020/Aromatic Volatiles (b):						
BENZENE	UG/L	0.5		<0.5	15P	16P
ETHYLBENZENE	UG/L	0.5		<0.5	<0.5P	2.6P
M,P-XYLENE (SUM OF ISOMERS)	UG/L	1.0		<1.0	2.0P	12P
TOLUENE	UG/L	0.5		<0.5	2.3P	20P
				ND	19.3	[illegible].6
Surrogates:						
4-CHLOROTOLUENE (88 – 118 % R)	%	1.0		103	100P	103P
FLUOROBENZENE (90 – 111 % R)	%	1.0		100	103P	100P
Dilution Factor:						
	--	--		1	1	1
SW7421/Lead, Total:						
LEAD	mg/L	0.001		0.0028 JB	0.0014 JB	0.0014 JB
				2.8	1.4	1.4
Dilution Factor:						
	--	--		1	1	1

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary by sample volume and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
P – Primary result.
NA – Not analyzed.
JB – Estimated quantitation based on blank data.

2 PS

G:\WPUSERS\1113\MYRTLE\SOIL\S2SWPOS.WK1

TABLE 7

SURFACE WATER ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a) Sample Date:	Sample SS20SW04 03/25/94	Duplicate SS20SWDUP 03/25/94
SW8020/Aromatic Volatiles (b):				
BENZENE	UG/L	0.5	14P	13P
ETHYLBENZENE	UG/L	0.5	2.3P	2.2P
M,P-XYLENE (SUM OF ISOMERS)	UG/L	1.0	9P	8.5P
TOLUENE	UG/L	0.5	18P	16P
Surrogates:			43-3	
4-CHLOROTOLUENE (88 - 118 % R)	%	1.0	103P	103P
FLUOROBENZENE (90 - 111 % R)	%	1.0	100P	100P
Dilution Factor:				
	--	--	1	1
SW7421/Lead, Total:				
LEAD	mg/L	0.001	0.0016 JB	0.002 JB
Dilution Factor:				
	--	--	1	1

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary by sample volume and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/second column.
P – Primary result.
NA – Not analyzed.
JB – Estimated quantitation based on blank data.

TABLE 6

GROUND WATER ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date:	MW-01 Background SS20GW01 04/07/94	MW-02 Sample SS20GW02 04/07/94	Duplicate SS20GWDUP 04/07/94
SW8020/Aromatic Volatiles (b):						
BENZENE	UG/L	0.5		<0.5	32P	29P
ETHYLBENZENE	UG/L	0.5		<0.5	<0.5P J	2.1P J
M,P-XYLENE (SUM OF ISOMERS)	UG/L	1.0		<1.0	<1.0P	<1.0P
TOLUENE	UG/L	0.5		<0.5	10P J	5.2P J
Total BTEX				ND	42	36.3
Surrogates:						
4-CHLOROTOLUENE (88 - 118 % R)	%	1.0		103	100P	100P
FLUOROBENZENE (90 - 111 % R)	%	1.0		100	103P	100P
Dilution Factor:	--	--		1	* 10 / 1	** 5 / 1
SW7421/Lead, Total:						
LEAD	mg/L	0.001		0.0057	<0.001	<0.001
Dilution Factor:	--	--		1	1	1

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary by sample volume and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/ second column.
P – Primary result.
* – Benzene 10X, all other compounds 1X.
** – Benzene 5X, all other compounds 1X.
JD – Estimated quantitation based on dilution.
J – Estimated quantitation based upon QC data.

3 pgs.

57

G:\WPUSERS\1113\MYRTLE\GWTB\S2GWPOS.WK1

TABLE 6

GROUND WATER ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date:	MW-03 SS20GW03 04/07/94	MW-04 SS20GW04 04/07/94	MW-05 SS20GW05 04/07/94	MW111 04/07/94
SW8020/Aromatic Volatiles (b):							
BENZENE	UG/L	0.5		<0.5	4.3P	1.7P	<0.5
ETHYLBENZENE	UG/L	0.5		<0.5	<0.5P	<0.5P	<0.5
M,P-XYLENE (SUM OF ISOMERS)	UG/L	1.0		<1.0	<1.0P	<1.0P	<1.0
TOLUENE	UG/L	0.5		<0.5	<0.5P	<0.5P	<0.5
Total BTEX				ND	4.3	1.7	ND
Surrogates:							
4-CHLOROTOLUENE (88 - 118 % R)	%	1.0		103	100P	103P	100
FLUOROBENZENE (90 - 111 % R)	%	1.0		100	103P	100P	100
Dilution Factor:	--	--		1	1	1	1
SW7421/Lead, Total:							
LEAD	mg/L	0.001		0.0017	0.0014	0.0019	<0.001
				1.7	1.4	1.9	
Dilution Factor:	--	--		1	1	1	1

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary by sample volume and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/ second column.
P – Primary result.
JD – Estimated quantitation based on dilution.

58

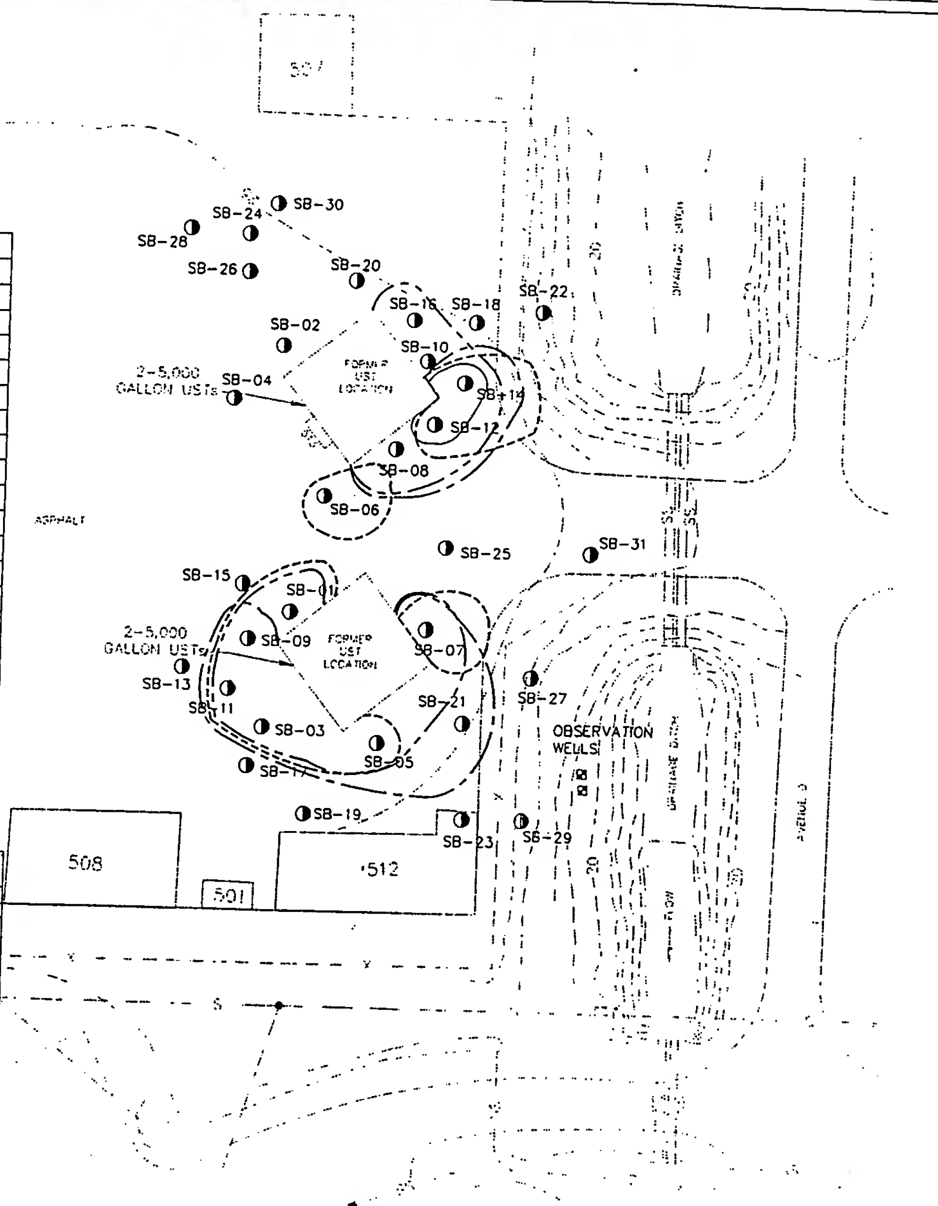
TABLE 6

GROUND WATER ANALYTICAL RESULTS, APRIL 1994
Law Environmental National Labs
MOGAS Storage Area
Former Myrtle Beach AFB, South Carolina

METHOD/ANALYTE	UNITS	DETECTION/ QUANTITATION LIMIT (a)	Sample Date:	MW112 04/07/94	MW113 04/07/94
SW8020/Aromatic Volatiles (b):					
BENZENE	UG/L	0.5		7800P JD	5100P JD
ETHYLBENZENE	UG/L	0.5		2500P JD	510P
M,P-XYLENE (SUM OF ISOMERS)	UG/L	1.0		16000P JD	1900P
TOLUENE	UG/L	0.5		38000P JD	4500P JD
Total BTEX				64,300	12,010
Surrogates:					
4-CHLOROTOLUENE (88 - 118 % R)	%	1.0		103P	105P
FLUOROBENZENE (90 - 111 % R)	%	1.0		103P	100P
Dilution Factor:					
	--	--		* 10000 / 1000	** 1000 / 100
SW7421/Lead, Total:					
LEAD	mg/L	0.001		0.0018	<0.001
				1.8	
Dilution Factor:					
	--	--		1	1

(a) – Detection/Quantitation limits listed are "ideal". Sample specific limits may vary by sample volume and/or dilution factors.
(b) – Results for this method are listed as: Primary/first column/ second column.
P – Primary result.
* – Benzene 10000X, all other compounds 1000X.
** – Benzene, Toluene 1000X, all other compounds 100X.
JD – Estimated quantitation based on dilution.
J – Estimated quantitation based upon QC data.

FIGURE 23
EXTENT OF SOIL CONTAMINATION MOGAS SITE
FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA



LEGEND

- 25 — CONTOUR LINES
- DRAINAGE
- SS — STORM SEWER
- S — SANITARY SEWER
- SOIL BORING LOCATION
- BTEX OVER 1 ppm
- TPH OVER 10 ppm
- BENZENE OVER 1 ppm
- BENZENE OVER 22 ppm

BTEX (mg/Kg)

BORING NO.	DEPTH (ft)	CONCENTRATION
SB01E	8-10	4.12
SB03D	6-8	5.17
SB03E	8-10	8.15
SB05E	8-10	1.70
SB07A	0-2	1.04
SB08D	6-8	49.8
SB09D	6-8	5.45
SB09E	8-10	76.6
SB10C*	4-6	1.17
SB10D	6-8	1.23
SB11E	8-10	224
SB12E	8-10	912
SB14D	6-8	1.44
SB14E	8-10	611
SB16B	2-4	7.07
SB16D	6-8	1.04
SB21B	2-4	5.84
SB21D	6-8	12.3

ONLY CONCENTRATIONS OVER 1 ppm ARE SHOWN ON THE MAP

BENZENE (mg/Kg)

BORING No	DEPTH (ft)	CONCENTRATION
~~SB03E~~	~~8-10~~	~~15 JD~~
SB05E	8-10	3.3 JD
SB08D	6-8	3.0 JD
~~SB09E~~	~~8-10~~	~~1.6 JD~~
SB11E	8-10	1.3 JD
SB12E	8-10	63 JD
SB14E	8-10	30 JD
SB21B	2-4	1.2 JD

ONLY CONCENTRATIONS OVER 1 ppm ARE SHOWN ON THE MAP

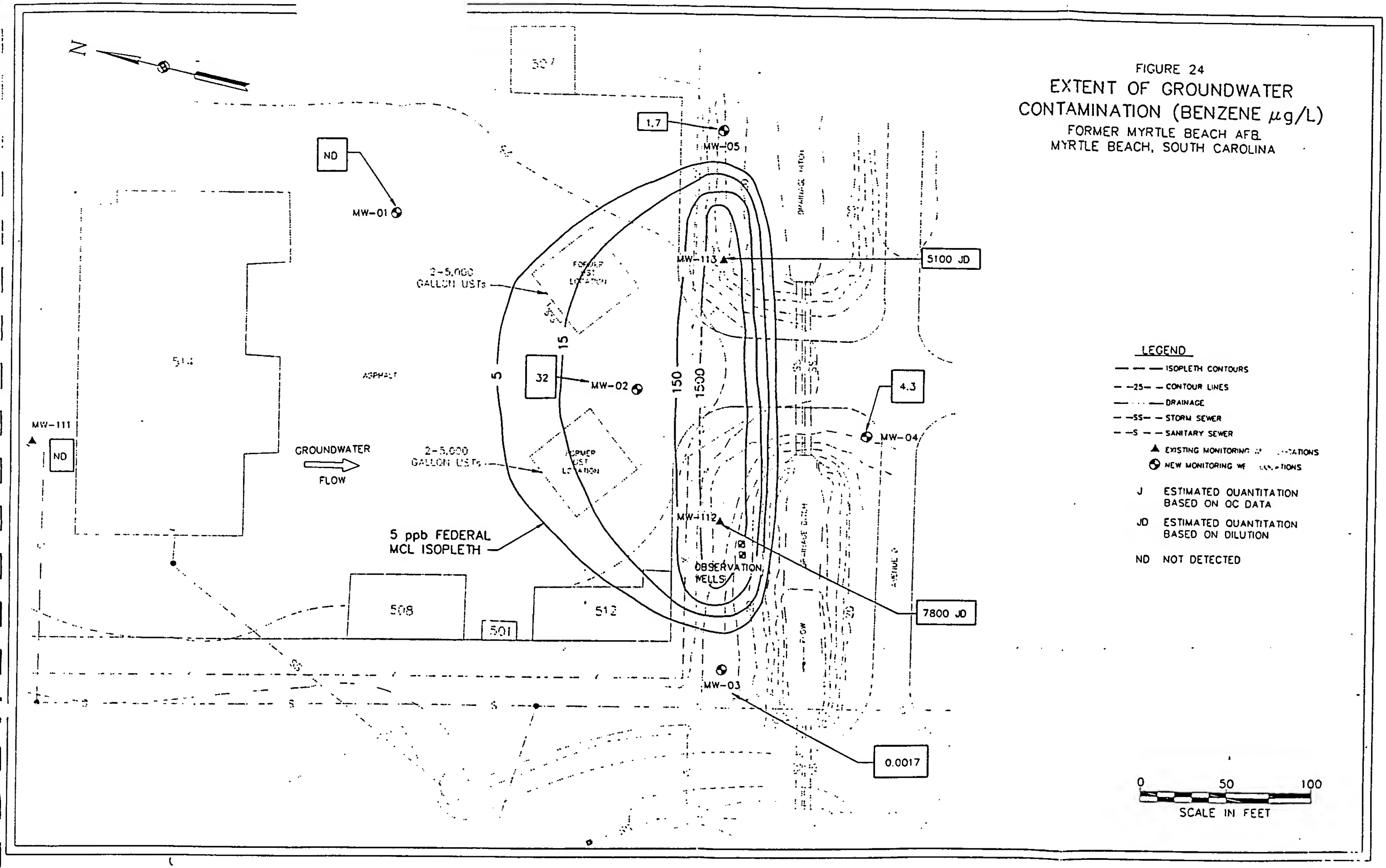
TPH (mg/Kg)

BORING No.	DEPTH (ft.)	CONCENTRATION
SB01E	8-10	12
SB03D	6-8	140
SB03E	8-10	39000 J
SB05E	8-10	610
SB06E	8-10	210
SB07A	0-2	13
SB09E	8-10	770
SB11E	8-10	400
SB12E	8-10	9200
SB14E	8-10	860

ONLY CONCENTPATIONS OVER 10 ppm ARE SHOWN ON THIS MAP

0 50 100
SCALE IN FEET

FILENAME: g. MBAFB MOGAS...



FILENAME: g:\MBAFB\MOGAS15.DWG

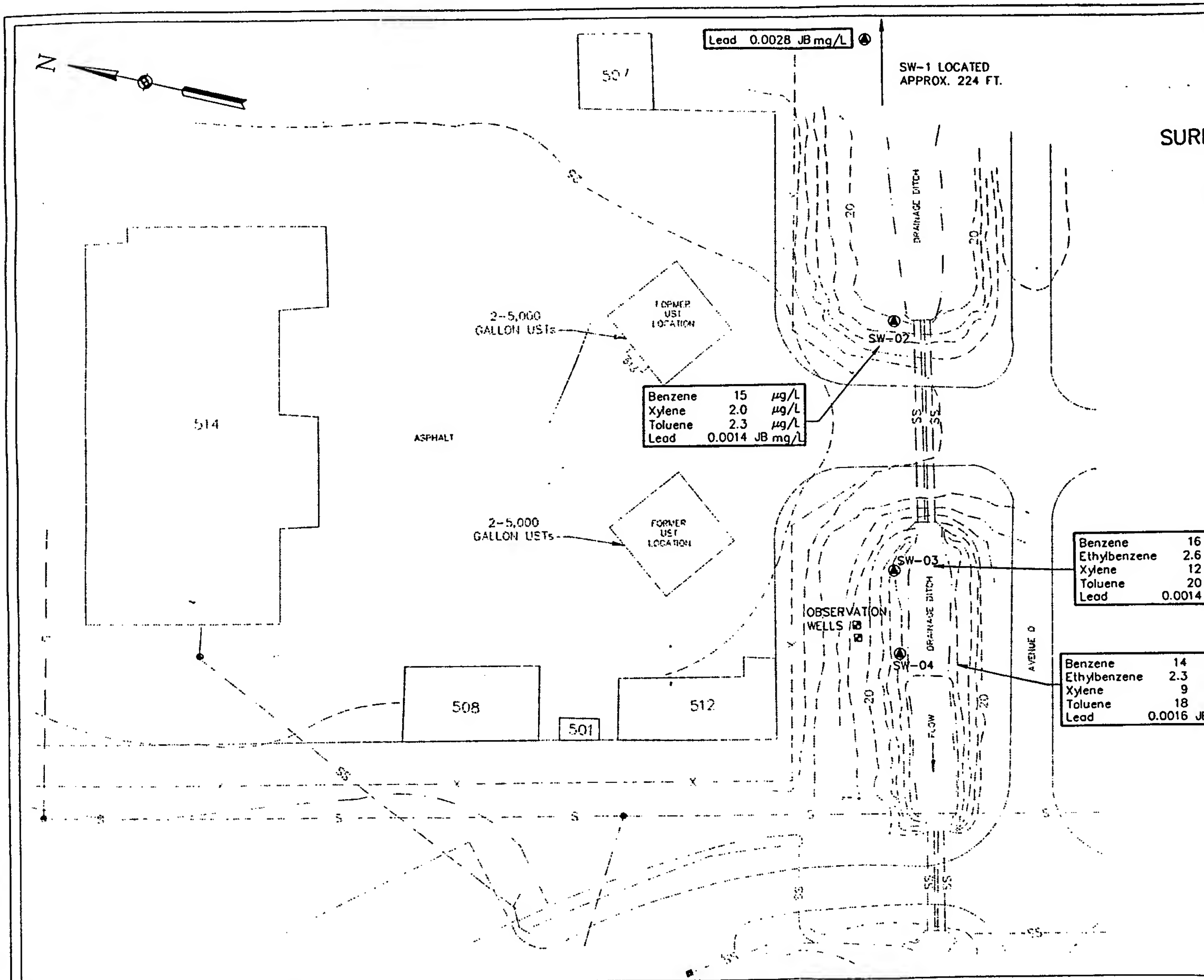


FIGURE 21

BTEX AND TOTAL LEAD CONCENTRATIONS SURFACE WATER SAMPLES, 1994 MOGAS SITE

FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA

LEGEND

- — 25 — CONTOUR LINES
- — · · · — DRAINAGE
- — SS — STORM SEWER
- — S — SANITARY SEWER
- ⊛ SURFACE WATER SAMPLE LOCATIONS
- JB ESTIMATED QUANTITATION BASED ON BLANK DATA

0 50 100
SCALE IN FEET

FILENAME: g:\MBAFB\MOGAS07.DWG

NORTH TO SOUTH CONTAMINANT CROSS SECTION (BENZENE) – MOGAS SITE

FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA

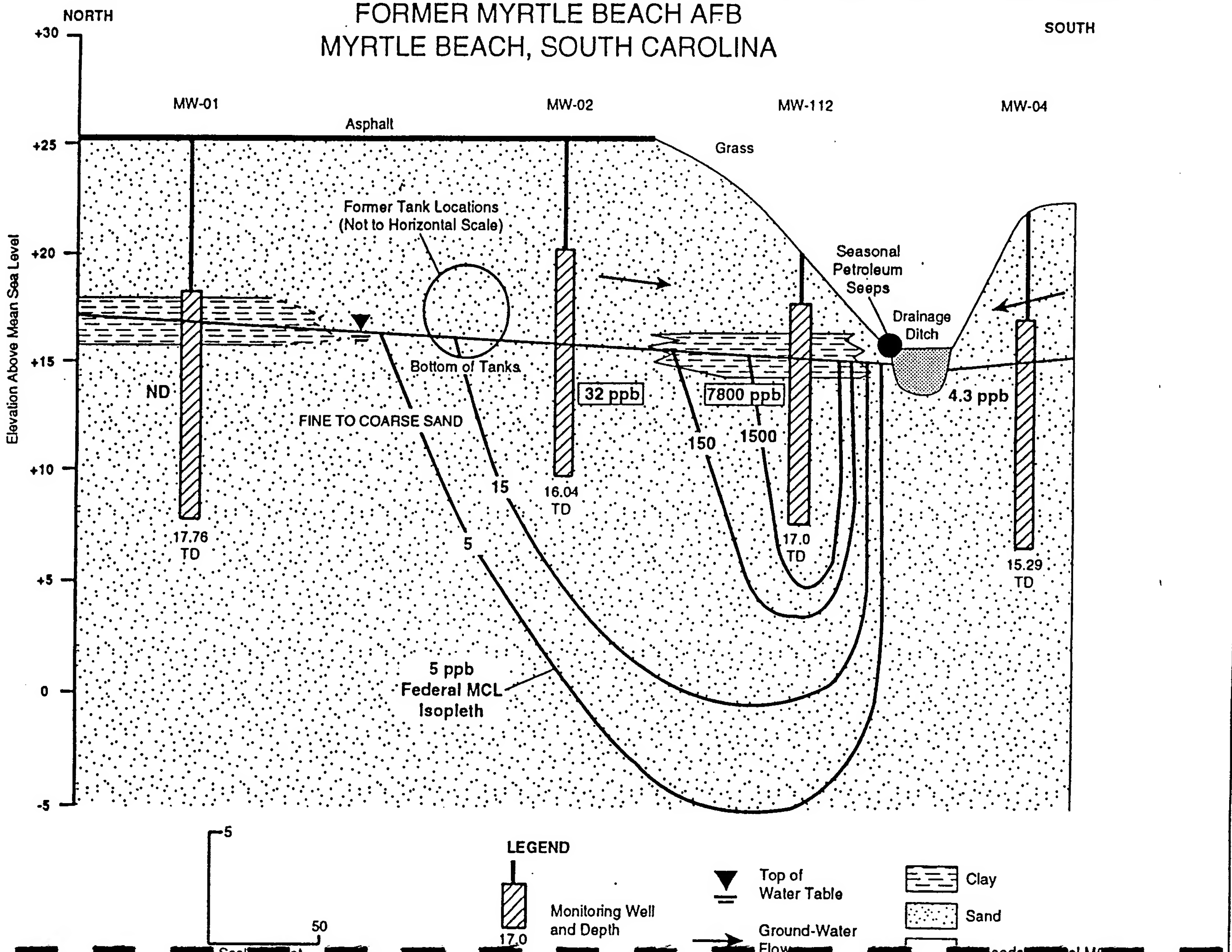
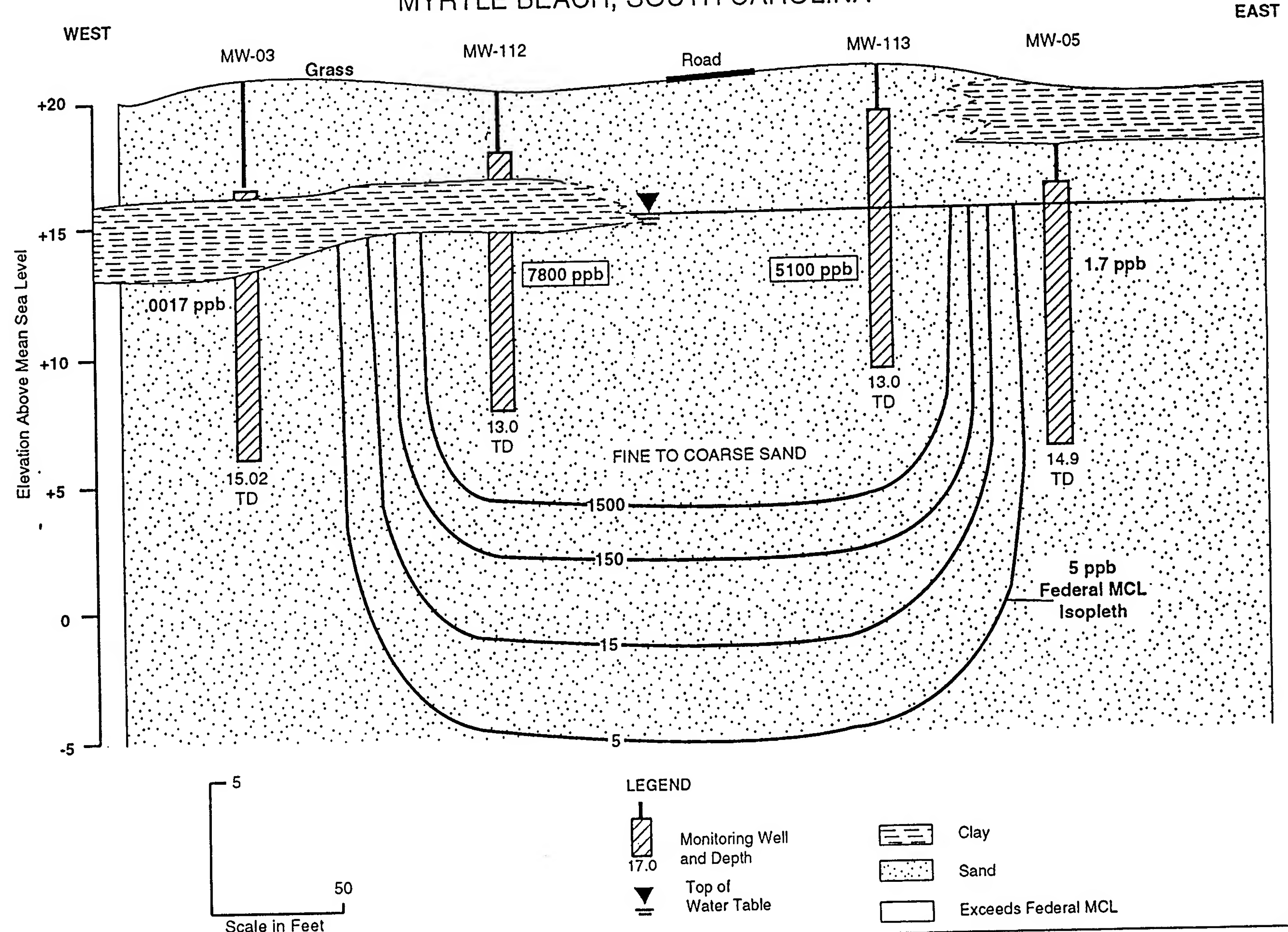


FIGURE 26

WEST TO EAST CONTAMINANT CROSS SECTION (BENZENE) – MOGAS SITE

FORMER MYRTLE BEACH AFB
MYRTLE BEACH, SOUTH CAROLINA



HTW DRILLING LOG

1. COMPANY NAME Law Environmental, Inc.	2. DRILLING SUBCONTRACTOR Law Engineering	HOLE No. MW-01 SHEET 1 OF 3 SHEETS
3. PROJECT Myrtle Beach AFB	4. LOCATION (CITY, STATE) Myrtle Beach, SC	
5. NAME OF DRILLER J. Oglesby/R.Hooten	6. MANUFACTURER'S DESIGNATION OF DRILL CME - 55	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT 6.25 in. I.D. HSA 2 in. O.D. High Carbon Steel Split Spoons	9. HOLE LOCATION (SITE) MOGAS Area 10. SURFACE ELEVATION 25.457	
8. WEATHER	11. DATE STARTED 3/9/94	12. DATE COMPLETED 3/9/94
13. OVERBURDEN THICKNESS N/A	16. DEPTH GROUNDWATER ENCOUNTERED 9.56 ft. 3/12/94	
14. DEPTH DRILLED INTO ROCK N/A	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
15. TOTAL DEPTH OF HOLE 17 ft.	18. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

19. GEOTECHNICAL SAMPLES (#)	DISTURBED	UNDISTURBED	20. TOTAL NUMBER OF CORE BOXES
N/A	X	—	N/A

21. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	22. TOTAL CORE RECOVERY%
None	—	—	—	—	—	N/A

23. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	24. SIGNATURE OF INSPECTOR
Monitoring Well	—	X	—	

25. CHECKED BY:	26. NAME OF INSPECTOR
Kevin Prochaska	Stephen Bouton

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	RECOVERY (FEET) h
		Asphalt = 0.5 ft.					
		Dark yellowish brown (10YR 3/4) fine to medium SAND; dry (SP/SC)	10 (Cuttings)				
	1.0						
	2.0						
	3.0						
	4.0						
			45				
		Very loose mottled olive gray (5Y 5/2) to olive yellow (2.5Y 6/6) fine SAND, little clay; damp (SC)				4, 2, 2, 2	1.6 (80%)
	5.0						

HTW DRILLING LOG

HOLE No.	MW-01
OJECT	yrtle Beach AFB
INSPECTOR	Stephen Bouton
SHEET	2 OF 3 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	RECOVERY (FEET) h
	5.0						
	6.0						
	7.0	Very loose/soft interbedded olive gray (5Y 5/2) CLAY and fine to medium SAND, little fine SAND in partings (SC)	30			5, 2, 2, 2	1.4 (70%)
	8.0						
	9.0	Firm gray (2.5Y 6/0) fine to medium SAND; wet (SP/SC)				3, 12, 10, 13	1.0 (50%)
	10.0						
	11.0						
	12.0						
	13.0						
	14.0						

HTW DRILLING LOG

HOLE No.
MW-01

PROJECT	INSPECTOR	SHEET 3 OF 3 SHEETS
Myrtle Beach AFB	Stephen Bouton	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	RECOVERY (FEET) h
	14.0						
	15.0	SAA, except trace clay (SC)				4, 3, 1, 1	1.0 (50%)
	16.0						
	17.0	TOTAL DEPTH = 17 ft.					
	18.0						
	19.0						
	20.0						
	21.0						
	22.0						
	23.0						

HTW DRILLING LOG

HOLE No. MW-02	SHEET 1 OF 3 SHEETS	
1. COMPANY NAME: Law Environmental, Inc.	2. DRILLING SUBCONTRACTOR: Law Engineering	
3. PROJECT: Myrtle Beach AFB	4. LOCATION (CITY, STATE): Myrtle Beach, SC	
5. NAME OF DRILLER: Robert Banks	6. MANUFACTURER'S DESIGNATION OF DRILL: CME - 75	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 6.25 in. I.D. HSA; 2 in. O.D. High Carbon Steel; Split Spoons	9. HOLE LOCATION (SITE): MOGAS Area	
	10. SURFACE ELEVATION: 25.95	
8. WEATHER	11. DATE STARTED: 3/26/94	12. DATE COMPLETED: 3/26/94
13. OVERBURDEN THICKNESS: N/A	16. DEPTH GROUNDWATER ENCOUNTERED: 7 ft.	
14. DEPTH DRILLED INTO ROCK: N/A	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
15. TOTAL DEPTH OF HOLE: 17.5 ft.	18. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

19. GEOTECHNICAL SAMPLES (#)	DISTURBED	UNDISTURBED	20. TOTAL NUMBER OF CORE BOXES
3	X	–	N/A

21. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	22. TOTAL CORE RECOVERY%
N/A	–	–	–	–	–	N/A

23. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	24. SIGNATURE OF INSPECTOR
Monitoring Well	–	X	–	

25. CHECKED BY	26. NAME OF INSPECTOR
Kevin Prochaska	Edward Dolan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	RECOVERY (FEET) h
		Asphalt = 0.5 ft. Top of Soil = 0 ft. Reddish brown (5YR 4/4) fine SAND, some clay; dry (fill) (SC)					Fill from 0 to 5 ft.
	1.0	Black (5YR 2.5/1) fine SAND, trace clay, trace medium sand; slight petroleum odor (fill) (SP/SC)					
	2.0						
	3.0	Gray (5YR 6/1) fine SAND, trace clay; dry, with shells (fill) (SP-SP/SC)					
	4.0	Very dark gray (5YR 4/1) fine SAND, trace clay (fill) (SP/SC) 100					
	5.0						

HTW DRILLING LOG

HOLE No.
MW-02

PROJECT	INSPECTOR	SHEET 2 OF 3 SHEETS
Myrtle Beach AFB	Edward Dolan	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	RECOVERY (FEET) h
	5.0	Very loose gray (N6/) fine SAND, little to some clay, moist, mottled greenish gray (5GY 6/1), mottled yellowish brown (10YR 5/8), with fine sand lenses at 5.25 to 5.5 and 7 to 7.25 ft. (SC)	7, 5, 1, 10			1, 1, 1, 2	Rec 2.0 ft (96%)
	6.0						
	7.0		5, 7, 10, 4			3, 2, 3, 8	Rec 2.0 ft (100%)
	8.0			Geotech Sample			
	9.0					1, 12, 15, 22	Rec 2.0 ft (100%)
	10.0	Firm, white (N8/) and light gray (N7/), medium SAND; wet (SP-SP/SC)		Geotech Sample			
	11.0						
	12.0						
	13.0	Loose, greenish gray (5G 6/1) fine SAND, little clay; wet, mottled gray (N6/), mottled yellowish brown (10YR 5/8) (SC)				2, 3, 4, 4	Rec 2.0 ft (67%)
	14.0						

HTW DRILLING LOG

HOLE No.	MW- 02
SHEET	3
OF	3 SHEETS

PROJECT: Myrtle Beach AFB

INSPECTOR:

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	RECOVERY (FEET) h
	14.0			Geotech Sample			
	15.0	Loose gray (N5/) medium SAND, trace clay; wet (SP-SP/SC)					
	16.0						
	17.0						
		TOTAL DEPTH = 17.5 ft.					
	18.0						
	19.0						
	20.0						
	21.0						
	22.0						
	23.0						

APPENDIX B

RISK-BASED INVESTIGATION

ANALYTICAL DATA

LIST OF TABLES--APPENDIX B

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
AS-01-01	9-Aug-95	4 - 6	1,2,3,4-Tetramethylbenzene	7200	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	1,2,3-Trimethylbenzene	940	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	1,2,4-Trimethylbenzene	25000 E	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	1,3,5-Trimethylbenzene	5600	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	Benzene	12 J	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	Chlorobenzene	39	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	Ethylbenzene	1100	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	Toluene	27	ug/kg	SW8020
AS-01-01	9-Aug-95	4 - 6	Xylene (total)	1800	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	1,2,3,4-Tetramethylbenzene	11	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	1,2,3-Trimethylbenzene	6.9	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	1,2,4-Trimethylbenzene	14	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	1,3,5-Trimethylbenzene	3 J	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	Benzene	4.8 U	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	Chlorobenzene	0.9 J	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	Ethylbenzene	1.4 J	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	Toluene	1.6 J	ug/kg	SW8020
AS-01-02	9-Aug-95	6 - 8	Xylene (total)	6.2	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	1,2,3,4-Tetramethylbenzene	5.6 U	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	1,2,3-Trimethylbenzene	5.6 U	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	1,2,4-Trimethylbenzene	5.6 U	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	1,3,5-Trimethylbenzene	5.6 U	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	Benzene	3.2 J	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	Chlorobenzene	5.6 U	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	Ethylbenzene	1.1 J	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	Toluene	4.5 J	ug/kg	SW8020
AS-01-03	9-Aug-95	12 - 14	Xylene (total)	3.6 J	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	Benzene	6.7	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	Chlorobenzene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	Ethylbenzene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	Toluene	4.8 U	ug/kg	SW8020
AS-02-01	10-Aug-95	3 - 5	Xylene (total)	1.7 J	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	Benzene	4.8 U	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	Chlorobenzene	4.8 U	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
AS-02-02	10-Aug-95	10 - 12	Ethylbenzene	4.8 U	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	Toluene	1.2 J	ug/kg	SW8020
AS-02-02	10-Aug-95	10 - 12	Xylene (total)	4.8 U	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	1,2,3-Trimethylbenzene	1.2 J	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	1,2,4-Trimethylbenzene	2.7 J	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	1,3,5-Trimethylbenzene	2 J	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	Benzene	16	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	Chlorobenzene	2.7 J	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	Ethylbenzene	10	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	Toluene	3.8 J	ug/kg	SW8020
MW-06-01	8-Aug-95	7 - 9	Xylene (total)	16	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	1,2,3,4-Tetramethylbenzene	4.9 U	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	1,2,3-Trimethylbenzene	0.8 J	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	1,2,4-Trimethylbenzene	0.9 J	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	1,3,5-Trimethylbenzene	0.7 J	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	Benzene	5.4	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	Ethylbenzene	1.1 J	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	Toluene	9.1	ug/kg	SW8020
MW-06-02	8-Aug-95	15 - 17	Xylene (total)	4.1 J	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	Benzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	Ethylbenzene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	Toluene	4.8 U	ug/kg	SW8020
MW-07-01	8-Aug-95	7 - 9	Xylene (total)	1.1 J	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	1,2,3,4-Tetramethylbenzene	5 U	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	1,2,3-Trimethylbenzene	5 U	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	1,2,4-Trimethylbenzene	1 J	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	1,3,5-Trimethylbenzene	5 U	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	Benzene	5 U	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	Chlorobenzene	5 U	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	Ethylbenzene	5 U	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	Toluene	1.2 J	ug/kg	SW8020
MW-07-02	8-Aug-95	9 - 11	Xylene (total)	1.3 J	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-07-03	8-Aug-95	16 - 17	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	Benzene	4.8 U	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	Ethylbenzene	4.8 U	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	Toluene	1.2 J	ug/kg	SW8020
MW-07-03	8-Aug-95	16 - 17	Xylene (total)	4.8 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	1,2,3-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	1,2,4-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	1,3,5-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	Benzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	Ethylbenzene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	Toluene	4.9 U	ug/kg	SW8020
MW-08-01	8-Aug-95	7 - 9	Xylene (total)	1 J	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	1,2,4-Trimethylbenzene	1.9 J	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	1,3,5-Trimethylbenzene	0.9 J	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	Benzene	0.8 J	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	Ethylbenzene	0.6 J	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	Toluene	2.8 J	ug/kg	SW8020
MW-08-02	8-Aug-95	11 - 13	Xylene (total)	2.6 J	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	1,2,3,4-Tetramethylbenzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	1,2,3-Trimethylbenzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	1,2,4-Trimethylbenzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	1,3,5-Trimethylbenzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	Benzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	Chlorobenzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	Ethylbenzene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	Toluene	7.6 U	ug/kg	SW8020
MW-08-03	8-Aug-95	17 - 19	Xylene (total)	7.6 U	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	1,2,3,4-Tetramethylbenzene	5.8 U	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	1,2,3-Trimethylbenzene	5.8 U	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	1,2,4-Trimethylbenzene	5.8 U	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	1,3,5-Trimethylbenzene	5.8 U	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	Benzene	4.9 J	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	Chlorobenzene	5.8 U	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	Ethylbenzene	1 J	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	TEH as Jet Fuel	15 U	ug/kg	M8015
MW-08-04	8-Aug-95	29 - 31	Toluene	5.3 J	ug/kg	SW8020
MW-08-04	8-Aug-95	29 - 31	TVH as Gasoline	0.3	ug/kg	M8015

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-08-04	8-Aug-95	29 - 31	Xylene (total)	1.9 J	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	4.9 U	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	1,2,3-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	1,2,4-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	1,3,5-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	Benzene	2.3 J	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	Ethylbenzene	4.9 U	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	TEH as Jet Fuel	12 U	ug/kg	M8015
MW-10-01	8-Aug-95	7 - 9	Toluene	1.7 J	ug/kg	SW8020
MW-10-01	8-Aug-95	7 - 9	TVH as Gasoline	0.3	ug/kg	M8015
MW-10-01	8-Aug-95	7 - 9	Xylene (total)	1.1 J	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	1,2,3,4-Tetramethylbenzene	5 U	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	1,2,3-Trimethylbenzene	5 U	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	1,2,4-Trimethylbenzene	5 U	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	1,3,5-Trimethylbenzene	5 U	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	Benzene	1.5 J	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	Chlorobenzene	5 U	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	Ethylbenzene	5 U	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	TEH as Jet Fuel	12 U	ug/kg	M8015
MW-10-02	8-Aug-95	11 - 13	Toluene	1.3 J	ug/kg	SW8020
MW-10-02	8-Aug-95	11 - 13	TVH as Gasoline	0.1 U	ug/kg	M8015
MW-10-02	8-Aug-95	11 - 13	Xylene (total)	1 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	1,2,3,4-Tetramethylbenzene	2.2 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	1,2,3-Trimethylbenzene	1 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	1,2,4-Trimethylbenzene	0.7 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	Benzene	2.6 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	Ethylbenzene	1.3 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	TEH as Jet Fuel	12 U	ug/kg	M8015
MW-10-03	8-Aug-95	15 - 17	Toluene	3.2 J	ug/kg	SW8020
MW-10-03	8-Aug-95	15 - 17	TVH as Gasoline	0.1 U	ug/kg	M8015
MW-10-03	8-Aug-95	15 - 17	Xylene (total)	3.9 J	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	4.9 U	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	1,2,3-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	1,2,4-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	1,3,5-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	Benzene	0.8 J	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	Ethylbenzene	4.9 U	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	Toluene	1.8 J	ug/kg	SW8020
MW-11-01	9-Aug-95	7 - 9	Xylene (total)	0.5 J	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-11-02	9-Aug-95	13 - 15	1,2,3,4-Tetramethylbenzene	6.3 U	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	1,2,3-Trimethylbenzene	6.3 U	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	1,2,4-Trimethylbenzene	6.3 U	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	1,3,5-Trimethylbenzene	6.3 U	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	Benzene	2.2 J	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	Chlorobenzene	6.3 U	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	Ethylbenzene	6.3 U	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	Toluene	3.8 J	ug/kg	SW8020
MW-11-02	9-Aug-95	13 - 15	Xylene (total)	0.8 J	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	4.9 U	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	1,2,3-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	1,2,4-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	1,3,5-Trimethylbenzene	1.5 J	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	Benzene	4.9 U	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	Ethylbenzene	4.9 U	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	Toluene	1.3 J	ug/kg	SW8020
MW-12-01	9-Aug-95	7 - 9	Xylene (total)	1.4 J	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	1,2,3,4-Tetramethylbenzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	1,2,3-Trimethylbenzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	1,2,4-Trimethylbenzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	1,3,5-Trimethylbenzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	Benzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	Chlorobenzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	Ethylbenzene	5 U	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	Toluene	0.9 J	ug/kg	SW8020
MW-12-02	9-Aug-95	11 - 13	Xylene (total)	5 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	1,2,3,4-Tetramethylbenzene	6.4 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	1,2,3-Trimethylbenzene	6.4 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	1,2,4-Trimethylbenzene	6.4 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	1,3,5-Trimethylbenzene	6.4 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	Benzene	1.2 J	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	Chlorobenzene	6.4 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	Ethylbenzene	6.4 U	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	Toluene	3.3 J	ug/kg	SW8020
MW-12-03	9-Aug-95	19 - 21	Xylene (total)	1 J	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	Benzene	4.8 U	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	Chlorobenzene	4.8 U	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-12-04	9-Aug-95	31 - 33	Ethylbenzene	4.8 U	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	Toluene	1.5 J	ug/kg	SW8020
MW-12-04	9-Aug-95	31 - 33	Xylene (total)	1.3 J	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	Benzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	Ethylbenzene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	Toluene	4.8 U	ug/kg	SW8020
MW-14-01	10-Aug-95	5 - 7	Xylene (total)	4.8 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	1,2,3,4-Tetramethylbenzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	1,2,3-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	1,2,4-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	1,3,5-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	Benzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	Chlorobenzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	Ethylbenzene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	TEH as Jet Fuel	12 U	ug/kg	M8015
MW-14-02	10-Aug-95	9 - 11	Toluene	4.7 U	ug/kg	SW8020
MW-14-02	10-Aug-95	9 - 11	TVH as Gasoline	0.1 U	ug/kg	M8015
MW-14-02	10-Aug-95	9 - 11	Xylene (total)	4.7 U	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	1,2,3,4-Tetramethylbenzene	4.7 U	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	1,2,3-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	1,2,4-Trimethylbenzene	1.2 J	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	1,3,5-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	Benzene	1.1 J	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	Chlorobenzene	4.7 U	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	Ethylbenzene	4.7 U	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	Toluene	3.6 J	ug/kg	SW8020
MW-15-01	10-Aug-95	3 - 5	Xylene (total)	1.6 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	1,2,3,4-Tetramethylbenzene	5.9	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	1,2,3-Trimethylbenzene	1.8 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	1,2,4-Trimethylbenzene	2.7 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	1,3,5-Trimethylbenzene	1.6 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	Benzene	0.7 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	Ethylbenzene	0.8 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	Toluene	4.3 J	ug/kg	SW8020
MW-15-02	10-Aug-95	9 - 11	Xylene (total)	5.9	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	1,2,3,4-Tetramethylbenzene	7.5 U	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-15-03	10-Aug-95	21 - 23	1,2,3-Trimethylbenzene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	1,2,4-Trimethylbenzene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	1,3,5-Trimethylbenzene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	Benzene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	Chlorobenzene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	Ethylbenzene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	Toluene	7.5 U	ug/kg	SW8020
MW-15-03	10-Aug-95	21 - 23	Xylene (total)	7.5 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	Benzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	Ethylbenzene	4.8 U	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	TEH as Jet Fuel	12 U	ug/kg	M8015
MW-15-04	10-Aug-95	33 - 35	Toluene	1.3 J	ug/kg	SW8020
MW-15-04	10-Aug-95	33 - 35	TVH as Gasoline	0.1 U	ug/kg	M8015
MW-15-04	10-Aug-95	33 - 35	Xylene (total)	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	1,2,3,4-Tetramethylbenzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	1,2,3-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	1,2,4-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	1,3,5-Trimethylbenzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	Benzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	Chlorobenzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	Ethylbenzene	4.8 U	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	Toluene	1 J	ug/kg	SW8020
MW-16-01	10-Aug-95	6 - 8	Xylene (total)	4.8 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	1,2,3,4-Tetramethylbenzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	1,2,3-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	1,2,4-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	1,3,5-Trimethylbenzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	Benzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	Chlorobenzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	Ethylbenzene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	Toluene	4.7 U	ug/kg	SW8020
MW-16-02	10-Aug-95	10 - 12	Xylene (total)	4.7 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	1,2,3,4-Tetramethylbenzene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	1,2,3-Trimethylbenzene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	1,2,4-Trimethylbenzene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	1,3,5-Trimethylbenzene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	Benzene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	Chlorobenzene	7.2 U	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-16-03	10-Aug-95	20 - 22	Ethylbenzene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	Toluene	7.2 U	ug/kg	SW8020
MW-16-03	10-Aug-95	20 - 22	Xylene (total)	7.2 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	1,2,3,4-Tetramethylbenzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	1,2,3-Trimethylbenzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	1,2,4-Trimethylbenzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	1,3,5-Trimethylbenzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	Benzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	Chlorobenzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	Ethylbenzene	5.1 U	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	TEH as Jet Fuel	13 U	ug/kg	M8015
MW-16-04	10-Aug-95	32 - 34	Toluene	1 J	ug/kg	SW8020
MW-16-04	10-Aug-95	32 - 34	TVH as Gasoline	0.1 U	ug/kg	M8015
MW-16-04	10-Aug-95	32 - 34	Xylene (total)	5.1 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	1,2,3,4-Tetramethylbenzene	4.9 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	1,2,3-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	1,2,4-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	1,3,5-Trimethylbenzene	4.9 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	Benzene	0.8 J	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	Chlorobenzene	4.9 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	Ethylbenzene	4.9 U	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	Toluene	1.2 J	ug/kg	SW8020
MW-18-01	11-Aug-95	5 - 7	Xylene (total)	4.9 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	1,2,3,4-Tetramethylbenzene	5.1 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	1,2,3-Trimethylbenzene	5.1 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	1,2,4-Trimethylbenzene	5.1 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	1,3,5-Trimethylbenzene	5.1 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	Benzene	0.8 J	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	Chlorobenzene	5.1 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	Ethylbenzene	5.1 U	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	Toluene	1.1 J	ug/kg	SW8020
MW-18-02	11-Aug-95	9 - 11	Xylene (total)	5.1 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	1,2,3,4-Tetramethylbenzene	7.8 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	1,2,3-Trimethylbenzene	7.8 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	1,2,4-Trimethylbenzene	7.8 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	1,3,5-Trimethylbenzene	7.8 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	Benzene	1.3 J	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	Chlorobenzene	7.8 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	Ethylbenzene	7.8 U	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	Toluene	2 J	ug/kg	SW8020
MW-18-03	11-Aug-95	20 - 22	Xylene (total)	7.8 U	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	1,2,3,4-Tetramethylbenzene	4.6 U	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
MW-18-04	11-Aug-95	32 - 34	1,2,3-Trimethylbenzene	4.6 U	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	1,2,4-Trimethylbenzene	4.6 U	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	1,3,5-Trimethylbenzene	4.6 U	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	Benzene	1 J	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	Chlorobenzene	4.6 U	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	Ethylbenzene	4.6 U	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	TEH as Jet Fuel	12 U	ug/kg	M8015
MW-18-04	11-Aug-95	32 - 34	Toluene	3.9 J	ug/kg	SW8020
MW-18-04	11-Aug-95	32 - 34	TVH as Gasoline	0.1 U	ug/kg	M8015
MW-18-04	11-Aug-95	32 - 34	Xylene (total)	4.6 U	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	3000	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	1,2,3-Trimethylbenzene	2600	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	1,2,4-Trimethylbenzene	9100	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	1,3,5-Trimethylbenzene	3400	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	Benzene	190 J	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	Chlorobenzene	220 J	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	Ethylbenzene	1100	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	Toluene	1700	ug/kg	SW8020
VENT-01-01	9-Aug-95	7 - 9	Xylene (total)	7000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	1,2,3,4-Tetramethylbenzene	140000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	1,2,3-Trimethylbenzene	170000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	1,2,4-Trimethylbenzene	650000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	1,3,5-Trimethylbenzene	220000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	Benzene	87000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	Chlorobenzene	20000 J	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	Ethylbenzene	180000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	Toluene	650000	ug/kg	SW8020
VENT-01-02	9-Aug-95	10 - 12	Xylene (total)	1000000	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	1,2,3,4-Tetramethylbenzene	340	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	1,2,3-Trimethylbenzene	620	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	1,2,4-Trimethylbenzene	2400	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	1,3,5-Trimethylbenzene	720	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	Benzene	890	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	Chlorobenzene	610 U	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	Ethylbenzene	1000	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	Toluene	6200	ug/kg	SW8020
VENT-02-01	9-Aug-95	7 - 9	Xylene (total)	5000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	1,2,3,4-Tetramethylbenzene	62000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	1,2,3-Trimethylbenzene	82000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	1,2,4-Trimethylbenzene	270000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	1,3,5-Trimethylbenzene	110000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	Benzene	29000 J	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	Chlorobenzene	27000 J	ug/kg	SW8020

TABLE B.1
SOIL DATA FOR VOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
VENT-02-02	9-Aug-95	11 - 13	Ethylbenzene	110000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	Toluene	300000	ug/kg	SW8020
VENT-02-02	9-Aug-95	11 - 13	Xylene (total)	500000	ug/kg	SW8020

TABLE B.2
SOIL DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result		Units	Analytical Method
AS-01-01	9-Aug-95	4 - 6	2,4-Dichlorophenol	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	2,4-Dimethylphenol	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	2-Methylnaphthalene	1500		ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	2-Methylphenol	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	4-Methylphenol	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Acenaphthene	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Anthracene	33	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Benzo(a)anthracene	110	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Benzo(a)pyrene	83	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Benzo(b)fluoranthene	130	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Benzo(g,h,i)perylene	59	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Benzo(k)fluoranthene	33	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Benzoic Acid	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Bis(2-ethylhexyl)phthalate	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Chrysene	110	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Fluoranthene	210	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Fluorene	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Indeno(1,2,3-cd)pyrene	57	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Naphthalene	460		ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Phenanthrene	140	J	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Phenol	21	U	ug/kg	SW8270
AS-01-01	9-Aug-95	4 - 6	Pyrene	220	J	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	2,4-Dichlorophenol	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	2,4-Dimethylphenol	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	2-Methylnaphthalene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	2-Methylphenol	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	4-Methylphenol	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Acenaphthene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Anthracene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Benzo(a)anthracene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Benzo(a)pyrene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Benzo(b)fluoranthene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Benzo(g,h,i)perylene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Benzo(k)fluoranthene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Benzoic Acid	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Bis(2-ethylhexyl)phthalate	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Chrysene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Fluoranthene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Fluorene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Indeno(1,2,3-cd)pyrene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Naphthalene	410	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Phenanthrene	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Phenol	21	U	ug/kg	SW8270
AS-01-02	9-Aug-95	6 - 8	Pyrene	21	U	ug/kg	SW8270

TABLE B.2
SOIL DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result		Units	Analytical Method
AS-02-02	10-Aug-95	10 - 12	2,4-Dichlorophenol	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	2,4-Dimethylphenol	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	2-Methylnaphthalene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	2-Methylphenol	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	4-Methylphenol	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Acenaphthene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Anthracene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Benzo(a)anthracene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Benzo(a)pyrene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Benzo(b)fluoranthene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Benzo(g,h,i)perylene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Benzo(k)fluoranthene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Benzoic Acid	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Bis(2-ethylhexyl)phthalate	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Chrysene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Fluoranthene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Fluorene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Indeno(1,2,3-cd)pyrene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Naphthalene	400	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Phenanthrene	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Phenol	20	U	ug/kg	SW8270
AS-02-02	10-Aug-95	10 - 12	Pyrene	20	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	2,4-Dichlorophenol	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	2,4-Dimethylphenol	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	2-Methylnaphthalene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	2-Methylphenol	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	4-Methylphenol	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Acenaphthene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Anthracene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Benzo(a)anthracene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Benzo(a)pyrene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Benzo(b)fluoranthene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Benzo(g,h,i)perylene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Benzo(k)fluoranthene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Benzoic Acid	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Bis(2-ethylhexyl)phthalate	30	J	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Chrysene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Fluoranthene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Fluorene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Indeno(1,2,3-cd)pyrene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Naphthalene	400	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Phenanthrene	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Phenol	40	U	ug/kg	SW8270
MW-06-01	8-Aug-95	7 - 9	Pyrene	40	U	ug/kg	SW8270

TABLE B.2
SOIL DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result		Units	Analytical Method
MW-06-02	8-Aug-95	15 - 17	2,4-Dichlorophenol	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	2,4-Dimethylphenol	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	2-Methylnaphthalene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	2-Methylphenol	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	4-Methylphenol	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Acenaphthene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Anthracene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Benzo(a)anthracene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Benzo(a)pyrene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Benzo(b)fluoranthene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Benzo(g,h,i)perylene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Benzo(k)fluoranthene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Benzoic Acid	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Bis(2-ethylhexyl)phthalate	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Chrysene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Fluoranthene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Fluorene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Indeno(1,2,3-cd)pyrene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Naphthalene	410	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Phenanthrene	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Phenol	41	U	ug/kg	SW8270
MW-06-02	8-Aug-95	15 - 17	Pyrene	41	U	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	2,4-Dichlorophenol	360	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	2,4-Dimethylphenol	21	U	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	2-Methylnaphthalene	2400		ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	2-Methylphenol	66	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	4-Methylphenol	120	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Acenaphthene	43	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Anthracene	100	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Benzo(a)anthracene	130	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Benzo(a)pyrene	69	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Benzo(b)fluoranthene	100	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Benzo(g,h,i)perylene	24	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Benzo(k)fluoranthene	38	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Benzoic Acid	21	U	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Bis(2-ethylhexyl)phthalate	21	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Chrysene	110	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Fluoranthene	370	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Fluorene	61	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Indeno(1,2,3-cd)pyrene	37	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Naphthalene	1300		ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Phenanthrene	400	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Phenol	88	J	ug/kg	SW8270
VENT-01-01	9-Aug-95	7 - 9	Pyrene	250	J	ug/kg	SW8270

TABLE B.2
SOIL DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result		Units	Analytical Method
VENT-01-02	9-Aug-95	10 - 12	2,4-Dichlorophenol	95	U	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	2,4-Dimethylphenol	95	U	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	2-Methylnaphthalene	30000		ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	2-Methylphenol	200	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	4-Methylphenol	95	U	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Acenaphthene	450	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Anthracene	800	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Benzo(a)anthracene	890	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Benzo(a)pyrene	490	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Benzo(b)fluoranthene	680	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Benzo(g,h,i)perylene	130	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Benzo(k)fluoranthene	260	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Benzoic Acid	95	U	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Bis(2-ethylhexyl)phthalate	95	U	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Chrysene	770	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Fluoranthene	2600		ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Fluorene	540	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Indeno(1,2,3-cd)pyrene	180	J	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Naphthalene	24000		ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Phenanthrene	3000		ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Phenol	95	U	ug/kg	SW8270
VENT-01-02	9-Aug-95	10 - 12	Pyrene	1900		ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	2,4-Dichlorophenol	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	2,4-Dimethylphenol	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	2-Methylnaphthalene	460		ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	2-Methylphenol	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	4-Methylphenol	68	J	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Acenaphthene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Anthracene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Benzo(a)anthracene	25	J	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Benzo(a)pyrene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Benzo(b)fluoranthene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Benzo(g,h,i)perylene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Benzo(k)fluoranthene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Benzoic Acid	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Bis(2-ethylhexyl)phthalate	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Chrysene	21	J	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Fluoranthene	58	J	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Fluorene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Indeno(1,2,3-cd)pyrene	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Naphthalene	350	J	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Phenanthrene	59	J	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Phenol	20	U	ug/kg	SW8270
VENT-02-01	9-Aug-95	7 - 9	Pyrene	43	J	ug/kg	SW8270

TABLE B.2
SOIL DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result		Units	Analytical Method
VENT-02-02	9-Aug-95	11 - 13	2,4-Dichlorophenol	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	2,4-Dimethylphenol	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	2-Methylnaphthalene	12000		ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	2-Methylphenol	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	4-Methylphenol	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Acenaphthene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Anthracene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Benzo(a)anthracene	100	J	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Benzo(a)pyrene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Benzo(b)fluoranthene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Benzo(g,h,i)perylene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Benzo(k)fluoranthene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Benzoic Acid	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Bis(2-ethylhexyl)phthalate	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Chrysene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Fluoranthene	240	J	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Fluorene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Indeno(1,2,3-cd)pyrene	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Naphthalene	12000		ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Phenanthrene	310	J	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Phenol	95	U	ug/kg	SW8270
VENT-02-02	9-Aug-95	11 - 13	Pyrene	190	J	ug/kg	SW8270

TABLE B.3
SOIL DATA FOR OTHER ANALYSES
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
AS-01-01	9-Aug-95	4 - 6	Nitrogen, Total Kjeldahl	749	mg/kg	E351.2
AS-01-01	9-Aug-95	4 - 6	pH	6.92	pH units	SW9045
AS-01-01	9-Aug-95	4 - 6	Phosphorus	3 U	mg/kg	E300.0
AS-01-02	9-Aug-95	6 - 8	pH	4.98	pH units	SW9045
AS-01-02	9-Aug-95	6 - 8	Phosphorus	3 U	mg/kg	E300.0
AS-02-02	10-Aug-95	10 - 12	Nitrogen, Total Kjeldahl	5.3 U	mg/kg	E351.2
AS-02-02	10-Aug-95	10 - 12	Phosphorus	6.1	mg/kg	E300.0
MW-08-02	8-Aug-95	11 - 13	Alkalinity, total (as CACO3)	30.2 U	mg/kg	E310.1
MW-08-02	8-Aug-95	11 - 13	Nitrogen, Total Kjeldahl	4.9 U	mg/kg	E351.2
MW-08-02	8-Aug-95	11 - 13	pH	4.32	pH units	SW9045
MW-08-02	8-Aug-95	11 - 13	Phosphorus	3 U	mg/kg	E300.0
MW-08-02	8-Aug-95	11 - 13	Total organic carbon	0.25	%	CO2COUL
MW-08-03	8-Aug-95	17 - 19	Alkalinity, total (as CACO3)	5590	mg/kg	E310.1
MW-08-03	8-Aug-95	17 - 19	Nitrogen, Total Kjeldahl	741	mg/kg	E351.2
MW-08-03	8-Aug-95	17 - 19	pH	8.45	pH units	SW9045
MW-08-03	8-Aug-95	17 - 19	Phosphorus	4.7 U	mg/kg	E300.0
MW-08-03	8-Aug-95	17 - 19	Total organic carbon	0.09 U	%	CO2COUL
MW-10-MC	9-Aug-95	3 - 5	Moisture, percent	12.5	%	E160.3
MW-15-02	10-Aug-95	9 - 11	Nitrogen, Total Kjeldahl	5.2 U	mg/kg	E351.2
MW-15-02	10-Aug-95	9 - 11	Phosphorus	3.1 U	mg/kg	E300.0
MW-15-02	10-Aug-95	9 - 11	Total organic carbon	0.06 U	%	CO2COUL
MW-15-03	10-Aug-95	21 - 23	Total organic carbon	1.34	%	CO2COUL
MW-15-04	10-Aug-95	33 - 35	Total organic carbon	0.14	%	CO2COUL
VENT-01-01	9-Aug-95	7 - 9	Alkalinity, total (as CACO3)	30.3 U	mg/kg	E310.1
VENT-01-01	9-Aug-95	7 - 9	Moisture, percent	17.7	%	E160.3
VENT-01-01	9-Aug-95	7 - 9	Nitrogen, Total Kjeldahl	6.1 U	mg/kg	E351.2
VENT-01-01	9-Aug-95	7 - 9	pH	5.04	pH units	SW9045
VENT-01-01	9-Aug-95	7 - 9	Phosphorus	3 U	mg/kg	E300.0
VENT-01-02	9-Aug-95	10 - 12	Alkalinity, total (as CACO3)	28.8 U	mg/kg	E310.1
VENT-01-02	9-Aug-95	10 - 12	Moisture, percent	13.2	%	E160.3
VENT-01-02	9-Aug-95	10 - 12	Nitrogen, Total Kjeldahl	5.3 U	mg/kg	E351.2
VENT-01-02	9-Aug-95	10 - 12	pH	6.98	pH units	SW9045
VENT-01-02	9-Aug-95	10 - 12	Phosphorus	2.9 U	mg/kg	E300.0
VENT-02-01	9-Aug-95	7 - 9	Alkalinity, total (as CACO3)	30.3 U	mg/kg	E310.1
VENT-02-01	9-Aug-95	7 - 9	Moisture, percent	17.6	%	E160.3
VENT-02-01	9-Aug-95	7 - 9	Nitrogen, Total Kjeldahl	5.3 U	mg/kg	E351.2

TABLE B.3
SOIL DATA FOR OTHER ANALYSES
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
VENT-02-01	9-Aug-95	7 - 9	pH	5.35	pH units	SW9045
VENT-02-01	9-Aug-95	7 - 9	Phosphorus	3 U	mg/kg	E300.0
VENT-02-01	9-Aug-95	7 - 9	Total organic carbon	0.06 U	%	CO2COUL
VENT-02-02	9-Aug-95	11 - 13	Alkalinity, total (as CACO3)	28.6 U	mg/kg	E310.1
VENT-02-02	9-Aug-95	11 - 13	Moisture, percent	12.7	%	E160.3
VENT-02-02	9-Aug-95	11 - 13	Nitrogen, Total Kjeldahl	5 U	mg/kg	E351.2
VENT-02-02	9-Aug-95	11 - 13	pH	6.6	pH units	SW9045
VENT-02-02	9-Aug-95	11 - 13	Phosphorus	2.8 U	mg/kg	E300.0
VENT-02-02	9-Aug-95	11 - 13	Total organic carbon	0.06 U	%	CO2COUL

TABLE B.4
SOIL GAS DATA
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
VW-1	Sep-95	3.5 - 11	Benzene	1,300	ppmv	TO-3
			Toluene	910	ppmv	TO-3
			Ethylbenzene	62	ppmv	TO-3
			Xylenes	120	ppmv	TO-3
			TVH	180,000	ppmv	TO-3
VW-2	Sep-95	3.4 - 10.9	Benzene	1,300	ppmv	TO-3
			Toluene	2,000	ppmv	TO-3
			Ethylbenzene	200	ppmv	TO-3
			Xylenes	410	ppmv	TO-3
			TVH	100,000	ppmv	TO-3
SV-2	Sep-95	4.5 - 7.5	Benzene	310	ppmv	TO-3
			Toluene	200	ppmv	TO-3
			Ethylbenzene	9	ppmv	TO-3
			Xylenes	15	ppmv	TO-3
			TVH	28,000	ppmv	TO-3
SV-7	Sep-95	5 - 10	Benzene	800	ppmv	TO-3
			Toluene	1,000	ppmv	TO-3
			Ethylbenzene	150	ppmv	TO-3
			Xylenes	280	ppmv	TO-3
			TVH	64,000	ppmv	TO-3
VW-1	20-Oct-95	3.5 - 11	O_2	0	%	FIELD
			CO_2	>25	%	FIELD
			TVH	>13,000	ppmv	FIELD
VW-2	20-Oct-95	3.4 - 10.9	O_2	2	%	FIELD
			CO_2	>25	%	FIELD
			TVH	>13,000	ppmv	FIELD
SV-1	20-Oct-95	5 - 8	O_2	0	%	FIELD
			CO_2	23	%	FIELD
			TVH	>13,000	ppmv	FIELD
SV-3	20-Oct-95	4.5 - 7.5	O_2	0	%	FIELD
			CO_2	>25	%	FIELD
			TVH	>13,000	ppmv	FIELD
SV-5	20-Oct-95	5 - 10	O_2	0	%	FIELD
			CO_2	>25	%	FIELD
			TVH	>13,000	ppmv	FIELD
SV-6	20-Oct-95	5 - 10	O_2	0	%	FIELD
			CO_2	>25	%	FIELD
			TVH	>13,000	ppmv	FIELD

TABLE B.4
SOIL GAS DATA
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Sample Interval (ft bgs: begin-end)	Analyte	Result	Units	Analytical Method
SV-7	20-Oct-95	5 - 10	O_2	0	%	FIELD
			CO_2	>25	%	FIELD
			TVH	>13,000	ppmv	FIELD
SV-8	20-Oct-95	5 - 10	O_2	0	%	FIELD
			CO_2	23	%	FIELD
			TVH	6,000	ppmv	FIELD
SV-1	7-Nov-95	5 - 8	O_2	18	%	FIELD
			CO_2	2	%	FIELD
			TVH	20	ppmv	FIELD
SV-2	7-Nov-95	4.5 - 7.5	O_2	1	%	FIELD
			CO_2	16	%	FIELD
			TVH	>13,000	ppmv	FIELD
SV-3	7-Nov-95	4.5 - 7.5	O_2	1	%	FIELD
			CO_2	17	%	FIELD
			TVH	9,500	ppmv	FIELD
SV-6	13-Nov-95	5 - 10	O_2	0	%	FIELD
			CO_2	12	%	FIELD
			TVH	>20,000	ppmv	FIELD
SV-7	13-Nov-95	5 - 10	O_2	16	%	FIELD
			CO_2	3	%	FIELD
			TVH	1,400	ppmv	FIELD
SV-8	13-Nov-95	5 - 10	O_2	20	%	FIELD
			CO_2	1	%	FIELD
			TVH	150	ppmv	FIELD
SV-5	24-Jan-96	5 - 10	O_2	12	%	FIELD
			CO_2	4	%	FIELD
			TVH	>10,000	ppmv	FIELD
SV-6	24-Jan-96	5 - 10	O_2	18	%	FIELD
			CO_2	1	%	FIELD
			TVH	3,100	ppmv	FIELD
SV-7	24-Jan-96	5 - 10	O_2	20	%	FIELD
			CO_2	1	%	FIELD
			TVH	1,000	ppmv	FIELD
SV-8	24-Jan-96	5 - 10	O_2	21	%	FIELD
			CO_2	1	%	FIELD
			TVH	38	ppmv	FIELD

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-01	1/95	Benzene	1.13		ug/L	RSKSOP-133
MW-01	1/95	Toluene	1.00	U	ug/L	RSKSOP-133
MW-01	1/95	Ethylbenzene	1.00	U	ug/L	RSKSOP-133
MW-01	1/95	p-Xylene	1.29		ug/L	RSKSOP-133
MW-01	1/95	m-Xylene	2.67		ug/L	RSKSOP-133
MW-01	1/95	o-Xylene	ND		ug/L	RSKSOP-133
MW-02	1/95	Benzene	29.90		ug/L	RSKSOP-133
MW-02	1/95	Toluene	1.24		ug/L	RSKSOP-133
MW-02	1/95	Ethylbenzene	1.28		ug/L	RSKSOP-133
MW-02	1/95	p-Xylene	1.18		ug/L	RSKSOP-133
MW-02	1/95	m-Xylene	1.84		ug/L	RSKSOP-133
MW-02	1/95	o-Xylene	1.18		ug/L	RSKSOP-133
MW-03	1/95	Benzene	1.00	U	ug/L	RSKSOP-133
MW-03	1/95	Toluene	ND		ug/L	RSKSOP-133
MW-03	1/95	Ethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	p-Xylene	ND		ug/L	RSKSOP-133
MW-03	1/95	m-Xylene	1.38		ug/L	RSKSOP-133
MW-03	1/95	o-Xylene	ND		ug/L	RSKSOP-133
MW-04	1/95	Benzene	3.82		ug/L	RSKSOP-133
MW-04	1/95	Toluene	1.00	U	ug/L	RSKSOP-133
MW-04	1/95	Ethylbenzene	4.11		ug/L	RSKSOP-133
MW-04	1/95	p-Xylene	0.99		ug/L	RSKSOP-133
MW-04	1/95	m-Xylene	1.21		ug/L	RSKSOP-133
MW-04	1/95	o-Xylene	1.00	U	ug/L	RSKSOP-133
MW-05	1/95	Benzene	4.06		ug/L	RSKSOP-133
MW-05	1/95	Toluene	ND		ug/L	RSKSOP-133
MW-05	1/95	Ethylbenzene	1.00	U	ug/L	RSKSOP-133
MW-05	1/95	p-Xylene	ND		ug/L	RSKSOP-133
MW-05	1/95	m-Xylene	0.99		ug/L	RSKSOP-133
MW-05	1/95	o-Xylene	ND		ug/L	RSKSOP-133
MW-111	1/95	Benzene	1.00	U	ug/L	RSKSOP-133
MW-111	1/95	Toluene	ND		ug/L	RSKSOP-133
MW-111	1/95	Ethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	p-Xylene	ND		ug/L	RSKSOP-133
MW-111	1/95	m-Xylene	0.92		ug/L	RSKSOP-133
MW-111	1/95	o-Xylene	ND		ug/L	RSKSOP-133
MW-111 Dup	1/95	Benzene	1.00	U	ug/L	RSKSOP-133
MW-111 Dup	1/95	Toluene	1.00	U	ug/L	RSKSOP-133

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-111 Dup	1/95	Ethylbenzene	ND	ug/L	RSKSOP-133
MW-111 Dup	1/95	p-Xylene	ND	ug/L	RSKSOP-133
MW-111 Dup	1/95	m-Xylene	0.94	ug/L	RSKSOP-133
MW-111 Dup	1/95	o-Xylene	ND	ug/L	RSKSOP-133
MW-112	1/95	Benzene	5430.00	ug/L	RSKSOP-133
MW-112	1/95	Toluene	23400.00	ug/L	RSKSOP-133
MW-112	1/95	Ethylbenzene	2430.00	ug/L	RSKSOP-133
MW-112	1/95	p-Xylene	3.07	ug/L	RSKSOP-133
MW-112	1/95	m-Xylene	6450.00	ug/L	RSKSOP-133
MW-112	1/95	o-Xylene	4390.00	ug/L	RSKSOP-133
MW-113	1/95	Benzene	773.00	ug/L	RSKSOP-133
MW-113	1/95	Toluene	379.00	ug/L	RSKSOP-133
MW-113	1/95	Ethylbenzene	117.00	ug/L	RSKSOP-133
MW-113	1/95	p-Xylene	69.50	ug/L	RSKSOP-133
MW-113	1/95	m-Xylene	78.30	ug/L	RSKSOP-133
MW-113	1/95	o-Xylene	116.00	ug/L	RSKSOP-133
MOC-02	1/95	Benzene	5.75	ug/L	RSKSOP-133
MOC-02	1/95	Toluene	62.10	ug/L	RSKSOP-133
MOC-02	1/95	Ethylbenzene	10.30	ug/L	RSKSOP-133
MOC-02	1/95	p-Xylene	9.98	ug/L	RSKSOP-133
MOC-02	1/95	m-Xylene	20.40	ug/L	RSKSOP-133
MOC-02	1/95	o-Xylene	13.20	ug/L	RSKSOP-133
MOC-03	1/95	Benzene	4.48	ug/L	RSKSOP-133
MOC-03	1/95	Toluene	28.90	ug/L	RSKSOP-133
MOC-03	1/95	Ethylbenzene	6.28	ug/L	RSKSOP-133
MOC-03	1/95	p-Xylene	6.15	ug/L	RSKSOP-133
MOC-03	1/95	m-Xylene	12.40	ug/L	RSKSOP-133
MOC-03	1/95	o-Xylene	8.22	ug/L	RSKSOP-133
MOC-04	1/95	Benzene	290.00	ug/L	RSKSOP-133
MOC-04	1/95	Toluene	671.00	ug/L	RSKSOP-133
MOC-04	1/95	Ethylbenzene	72.10	ug/L	RSKSOP-133
MOC-04	1/95	p-Xylene	72.80	ug/L	RSKSOP-133
MOC-04	1/95	m-Xylene	187.00	ug/L	RSKSOP-133
MOC-04	1/95	o-Xylene	118.00	ug/L	RSKSOP-133
MOC-08	1/95	Benzene	48.30	ug/L	RSKSOP-133
MOC-08	1/95	Toluene	23.50	ug/L	RSKSOP-133
MOC-08	1/95	Ethylbenzene	6.45	ug/L	RSKSOP-133
MOC-08	1/95	p-Xylene	5.55	ug/L	RSKSOP-133

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MOC-08	1/95	m-Xylene	10.80	ug/L	RSKSOP-133
MOC-08	1/95	o-Xylene	7.05	ug/L	RSKSOP-133
MOC-08 Dup	1/95	Benzene	46.30	ug/L	RSKSOP-133
MOC-08 Dup	1/95	Toluene	20.80	ug/L	RSKSOP-133
MOC-08 Dup	1/95	Ethylbenzene	7.81	ug/L	RSKSOP-133
MOC-08 Dup	1/95	p-Xylene	5.20	ug/L	RSKSOP-133
MOC-08 Dup	1/95	m-Xylene	10.70	ug/L	RSKSOP-133
MOC-08 Dup	1/95	o-Xylene	6.69	ug/L	RSKSOP-133
MOC-08	1/95	Benzene	1.68	ug/L	RSKSOP-133
MOC-08	1/95	Toluene	15.70	ug/L	RSKSOP-133
MOC-08	1/95	Ethylbenzene	4.51	ug/L	RSKSOP-133
MOC-08	1/95	p-Xylene	4.49	ug/L	RSKSOP-133
MOC-08	1/95	m-Xylene	8.85	ug/L	RSKSOP-133
MOC-08	1/95	o-Xylene	5.84	ug/L	RSKSOP-133
MOC-11	1/95	Benzene	12.10	ug/L	RSKSOP-133
MOC-11	1/95	Toluene	17.50	ug/L	RSKSOP-133
MOC-11	1/95	Ethylbenzene	4.70	ug/L	RSKSOP-133
MOC-11	1/95	p-Xylene	5.13	ug/L	RSKSOP-133
MOC-11	1/95	m-Xylene	10.80	ug/L	RSKSOP-133
MOC-11	1/95	o-Xylene	6.41	ug/L	RSKSOP-133
MOV-01-3	1/95	Benzene	5960.00	ug/L	RSKSOP-133
MOV-01-3	1/95	Toluene	19400.00	ug/L	RSKSOP-133
MOV-01-3	1/95	Ethylbenzene	2690.00	ug/L	RSKSOP-133
MOV-01-3	1/95	p-Xylene	1980.00	ug/L	RSKSOP-133
MOV-01-3	1/95	m-Xylene	4040.00	ug/L	RSKSOP-133
MOV-01-3	1/95	o-Xylene	3020.00	ug/L	RSKSOP-133
MOC-05	1/95	Benzene	4850.00	ug/L	RSKSOP-133
MOC-05	1/95	Toluene	6800.00	ug/L	RSKSOP-133
MOC-05	1/95	Ethylbenzene	912.00	ug/L	RSKSOP-133
MOC-05	1/95	p-Xylene	860.00	ug/L	RSKSOP-133
MOC-05	1/95	m-Xylene	1540.00	ug/L	RSKSOP-133
MOC-05	1/95	o-Xylene	1140.00	ug/L	RSKSOP-133
MW-01	1/95	1,3,5-Trimethylbenzene	ND	ug/L	RSKSOP-133
MW-01	1/95	1,2,4-Trimethylbenzene	ND	ug/L	RSKSOP-133
MW-01	1/95	1,2,3-Trimethylbenzene	ND	ug/L	RSKSOP-133
MW-01	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MW-01	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MW-01	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-01	1/95	FUEL CARBON	41.40		ug/L	RSKSOP-133
MW-02	1/95	1,3,5-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-02	1/95	1,2,4-Trimethylbenzene	1.76		ug/L	RSKSOP-133
MW-02	1/95	1,2,3-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-02	1/95	1,2,4,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-02	1/95	1,2,3,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-02	1/95	1,2,3,4-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-02	1/95	FUEL CARBON	140.00		ug/L	RSKSOP-133
MW-03	1/95	1,3,5-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	1,2,4-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	1,2,3-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	1,2,4,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	1,2,3,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	1,2,3,4-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-03	1/95	FUEL CARBON	3.76		ug/L	RSKSOP-133
MW-04	1/95	1,3,5-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-04	1/95	1,2,4-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-04	1/95	1,2,3-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-04	1/95	1,2,4,5-Tetramethylbenzene	1.16		ug/L	RSKSOP-133
MW-04	1/95	1,2,3,5-Tetramethylbenzene	1.07		ug/L	RSKSOP-133
MW-04	1/95	1,2,3,4-Tetramethylbenzene	1.35		ug/L	RSKSOP-133
MW-04	1/95	FUEL CARBON	107.00		ug/L	RSKSOP-133
MW-05	1/95	1,3,5-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-05	1/95	1,2,4-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-05	1/95	1,2,3-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-05	1/95	1,2,4,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-05	1/95	1,2,3,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-05	1/95	1,2,3,4-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-05	1/95	FUEL CARBON	41.00		ug/L	RSKSOP-133
MW-111	1/95	1,3,5-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	1,2,4-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	1,2,3-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	1,2,4,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	1,2,3,5-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	1,2,3,4-Tetramethylbenzene	ND		ug/L	RSKSOP-133
MW-111	1/95	FUEL CARBON	1.00	U	ug/L	RSKSOP-133
MW-111 Dup	1/95	1,3,5-Trimethylbenzene	ND		ug/L	RSKSOP-133
MW-111 Dup	1/95	1,2,4-Trimethylbenzene	ND		ug/L	RSKSOP-133

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-111 Dup	1/95	1,2,3-Trimethylbenzene	ND	ug/L	RSKSOP-133
MW-111 Dup	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MW-111 Dup	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MW-111 Dup	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MW-111 Dup	1/95	FUEL CARBON	1.00 U	ug/L	RSKSOP-133
MW-112	1/95	1,3,5-Trimethylbenzene	622.00	ug/L	RSKSOP-133
MW-112	1/95	1,2,4-Trimethylbenzene	2950.00	ug/L	RSKSOP-133
MW-112	1/95	1,2,3-Trimethylbenzene	881.00	ug/L	RSKSOP-133
MW-112	1/95	1,2,4,5-Tetramethylbenzene	76.40	ug/L	RSKSOP-133
MW-112	1/95	1,2,3,5-Tetramethylbenzene	134.00	ug/L	RSKSOP-133
MW-112	1/95	1,2,3,4-Tetramethylbenzene	74.40	ug/L	RSKSOP-133
MW-112	1/95	FUEL CARBON	47700.00	ug/L	RSKSOP-133
MW-113	1/95	1,3,5-Trimethylbenzene	21.20	ug/L	RSKSOP-133
MW-113	1/95	1,2,4-Trimethylbenzene	113.00	ug/L	RSKSOP-133
MW-113	1/95	1,2,3-Trimethylbenzene	41.00	ug/L	RSKSOP-133
MW-113	1/95	1,2,4,5-Tetramethylbenzene	6.19	ug/L	RSKSOP-133
MW-113	1/95	1,2,3,5-Tetramethylbenzene	8.91	ug/L	RSKSOP-133
MW-113	1/95	1,2,3,4-Tetramethylbenzene	4.50	ug/L	RSKSOP-133
MW-113	1/95	FUEL CARBON	2090.00	ug/L	RSKSOP-133
MOC-02	1/95	1,3,5-Trimethylbenzene	4.19	ug/L	RSKSOP-133
MOC-02	1/95	1,2,4-Trimethylbenzene	11.00	ug/L	RSKSOP-133
MOC-02	1/95	1,2,3-Trimethylbenzene	4.31	ug/L	RSKSOP-133
MOC-02	1/95	1,2,4,5-Tetramethylbenzene	BLQ	ug/L	RSKSOP-133
MOC-02	1/95	1,2,3,5-Tetramethylbenzene	BLQ	ug/L	RSKSOP-133
MOC-02	1/95	1,2,3,4-Tetramethylbenzene	BLQ	ug/L	RSKSOP-133
MOC-02	1/95	FUEL CARBON	152.00	ug/L	RSKSOP-133
MOC-03	1/95	1,3,5-Trimethylbenzene	3.22	ug/L	RSKSOP-133
MOC-03	1/95	1,2,4-Trimethylbenzene	7.34	ug/L	RSKSOP-133
MOC-03	1/95	1,2,3-Trimethylbenzene	3.02	ug/L	RSKSOP-133
MOC-03	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-03	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-03	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-03	1/95	FUEL CARBON	90.60	ug/L	RSKSOP-133
MOC-04	1/95	1,3,5-Trimethylbenzene	28.80	ug/L	RSKSOP-133
MOC-04	1/95	1,2,4-Trimethylbenzene	125.00	ug/L	RSKSOP-133
MOC-04	1/95	1,2,3-Trimethylbenzene	37.70	ug/L	RSKSOP-133
MOC-04	1/95	1,2,4,5-Tetramethylbenzene	5.07	ug/L	RSKSOP-133
MOC-04	1/95	1,2,3,5-Tetramethylbenzene	10.70	ug/L	RSKSOP-133

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MOC-04	1/95	1,2,3,4-Tetramethylbenzene	4.74	ug/L	RSKSOP-133
MOC-04	1/95	FUEL CARBON	1910.00	ug/L	RSKSOP-133
MOC-8	1/95	1,3,5-Trimethylbenzene	3.19	ug/L	RSKSOP-133
MOC-8	1/95	1,2,4-Trimethylbenzene	7.35	ug/L	RSKSOP-133
MOC-8	1/95	1,2,3-Trimethylbenzene	2.88	ug/L	RSKSOP-133
MOC-8	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-8	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-8	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-8	1/95	FUEL CARBON	245.00	ug/L	RSKSOP-133
MOC-8 Dup	1/95	1,3,5-Trimethylbenzene	3.05	ug/L	RSKSOP-133
MOC-8 Dup	1/95	1,2,4-Trimethylbenzene	6.85	ug/L	RSKSOP-133
MOC-8 Dup	1/95	1,2,3-Trimethylbenzene	2.58	ug/L	RSKSOP-133
MOC-8 Dup	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-8 Dup	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-8 Dup	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-8 Dup	1/95	FUEL CARBON	231.00	ug/L	RSKSOP-133
MOC-08	1/95	1,3,5-Trimethylbenzene	2.90	ug/L	RSKSOP-133
MOC-08	1/95	1,2,4-Trimethylbenzene	6.02	ug/L	RSKSOP-133
MOC-08	1/95	1,2,3-Trimethylbenzene	2.64	ug/L	RSKSOP-133
MOC-08	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-08	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-08	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-08	1/95	FUEL CARBON	58.70	ug/L	RSKSOP-133
MOC-11	1/95	1,3,5-Trimethylbenzene	3.62	ug/L	RSKSOP-133
MOC-11	1/95	1,2,4-Trimethylbenzene	9.10	ug/L	RSKSOP-133
MOC-11	1/95	1,2,3-Trimethylbenzene	3.36	ug/L	RSKSOP-133
MOC-11	1/95	1,2,4,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-11	1/95	1,2,3,5-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-11	1/95	1,2,3,4-Tetramethylbenzene	ND	ug/L	RSKSOP-133
MOC-11	1/95	FUEL CARBON	105.00	ug/L	RSKSOP-133
MOV-01-3	1/95	1,3,5-Trimethylbenzene	378.00	ug/L	RSKSOP-133
MOV-01-3	1/95	1,2,4-Trimethylbenzene	1580.00	ug/L	RSKSOP-133
MOV-01-3	1/95	1,2,3-Trimethylbenzene	513.00	ug/L	RSKSOP-133
MOV-01-3	1/95	1,2,4,5-Tetramethylbenzene	45.00	ug/L	RSKSOP-133
MOV-01-3	1/95	1,2,3,5-Tetramethylbenzene	73.30	ug/L	RSKSOP-133
MOV-01-3	1/95	1,2,3,4-Tetramethylbenzene	38.80	ug/L	RSKSOP-133
MOV-01-3	1/95	FUEL CARBON	37100.00	ug/L	RSKSOP-133
MOC-05	1/95	1,3,5-Trimethylbenzene	209.00	ug/L	RSKSOP-133

TABLE B.5
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS AND FUEL CARBON
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MOC-05	1/95	1,2,4-Trimethylbenzene	950.00	ug/L	RSKSOP-133
MOC-05	1/95	1,2,3-Trimethylbenzene	291.00	ug/L	RSKSOP-133
MOC-05	1/95	1,2,4,5-Tetramethylbenzene	31.80	ug/L	RSKSOP-133
MOC-05	1/95	1,2,3,5-Tetramethylbenzene	53.30	ug/L	RSKSOP-133
MOC-05	1/95	1,2,3,4-Tetramethylbenzene	29.40	ug/L	RSKSOP-133
MOC-05	1/95	FUEL CARBON	15800.00	ug/L	RSKSOP-133

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
AS-01	29-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
AS-01	29-Aug-95	1,2,3-Trimethylbenzene	5.4	ug/l	E602
AS-01	29-Aug-95	1,2,4-Trimethylbenzene	19	ug/l	E602
AS-01	29-Aug-95	1,3,5-Trimethylbenzene	4.1	ug/l	E602
AS-01	29-Aug-95	Benzene	15	ug/l	E602
AS-01	29-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
AS-01	29-Aug-95	Ethylbenzene	13	ug/l	E602
AS-01	29-Aug-95	Toluene	47	ug/l	E602
AS-01	29-Aug-95	Xylene (total)	48	ug/l	E602
AS-02	31-Aug-95	1,2,3,4-Tetramethylbenzene	10 U	ug/l	E602
AS-02	31-Aug-95	1,2,3-Trimethylbenzene	13	ug/l	E602
AS-02	31-Aug-95	1,2,4-Trimethylbenzene	53	ug/l	E602
AS-02	31-Aug-95	1,3,5-Trimethylbenzene	7.8	ug/l	E602
AS-02	31-Aug-95	Benzene	600	ug/l	E602
AS-02	31-Aug-95	Chlorobenzene	4 U	ug/l	E602
AS-02	31-Aug-95	Ethylbenzene	77	ug/l	E602
AS-02	31-Aug-95	Toluene	350	ug/l	E602
AS-02	31-Aug-95	Xylene (total)	160	ug/l	E602
MOC-02	28-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-02	28-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MOC-02	28-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-02	28-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-02	28-Aug-95	Benzene	1.6	ug/l	E602
MOC-02	28-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-02	28-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-02	28-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-02	28-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MOC-03	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MOC-03	1-Sep-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MOC-03	1-Sep-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-03	1-Sep-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-03	1-Sep-95	Benzene	2.8	ug/l	E602
MOC-03	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-03	1-Sep-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-03	1-Sep-95	Toluene	0.4 U	ug/l	E602
MOC-03	1-Sep-95	Xylene (total)	0.4 U	ug/l	E602
MOC-04	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MOC-04	1-Sep-95	1,2,3-Trimethylbenzene	2.1	ug/l	E602
MOC-04	1-Sep-95	1,2,4-Trimethylbenzene	7.2	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MOC-04	1-Sep-95	1,3,5-Trimethylbenzene	1	ug/l	E602
MOC-04	1-Sep-95	Benzene	80	ug/l	E602
MOC-04	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-04	1-Sep-95	Ethylbenzene	9.1	ug/l	E602
MOC-04	1-Sep-95	Toluene	120	ug/l	E602
MOC-04	1-Sep-95	Xylene (total)	47	ug/l	E602
MOC-05	29-Aug-95	1,2,3,4-Tetramethylbenzene	18	ug/l	E602
MOC-05	29-Aug-95	1,2,3-Trimethylbenzene	160	ug/l	E602
MOC-05	29-Aug-95	1,2,4-Trimethylbenzene	510	ug/l	E602
MOC-05	29-Aug-95	1,3,5-Trimethylbenzene	100	ug/l	E602
MOC-05	29-Aug-95	Benzene	3900	ug/l	E602
MOC-05	29-Aug-95	Chlorobenzene	10	ug/l	E602
MOC-05	29-Aug-95	Ethylbenzene	450	ug/l	E602
MOC-05	29-Aug-95	Toluene	5200	ug/l	E602
MOC-05	29-Aug-95	Xylene (total)	2600	ug/l	E602
MOC-07	29-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-07	29-Aug-95	1,2,3-Trimethylbenzene	1.9	ug/l	E602
MOC-07	29-Aug-95	1,2,4-Trimethylbenzene	2.7	ug/l	E602
MOC-07	29-Aug-95	1,3,5-Trimethylbenzene	1.5	ug/l	E602
MOC-07	29-Aug-95	Benzene	40	ug/l	E602
MOC-07	29-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-07	29-Aug-95	Ethylbenzene	2.5	ug/l	E602
MOC-07	29-Aug-95	Toluene	8.3	ug/l	E602
MOC-07	29-Aug-95	Xylene (total)	8.2	ug/l	E602
MOC-08	28-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-08	28-Aug-95	1,2,3-Trimethylbenzene	1.6	ug/l	E602
MOC-08	28-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-08	28-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-08	28-Aug-95	Benzene	0.4 U	ug/l	E602
MOC-08	28-Aug-95	Chlorobenzene	1.4	ug/l	E602
MOC-08	28-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-08	28-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-08	28-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MOC-10	29-Aug-95	1,2,3,4-Tetramethylbenzene	5 U	ug/l	E602
MOC-10	29-Aug-95	1,2,3-Trimethylbenzene	32	ug/l	E602
MOC-10	29-Aug-95	1,2,4-Trimethylbenzene	36	ug/l	E602
MOC-10	29-Aug-95	1,3,5-Trimethylbenzene	17	ug/l	E602
MOC-10	29-Aug-95	Benzene	330	ug/l	E602
MOC-10	29-Aug-95	Chlorobenzene	4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MOC-10	29-Aug-95	Ethylbenzene	140	ug/l	E602
MOC-10	29-Aug-95	Toluene	57	ug/l	E602
MOC-10	29-Aug-95	Xylene (total)	100	ug/l	E602
MOC-11	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MOC-11	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MOC-11	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-11	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-11	31-Aug-95	Benzene	7.2	ug/l	E602
MOC-11	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-11	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-11	31-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-11	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MOC-12	29-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-12	29-Aug-95	1,2,3-Trimethylbenzene	1.5	ug/l	E602
MOC-12	29-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-12	29-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-12	29-Aug-95	Benzene	3.2	ug/l	E602
MOC-12	29-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-12	29-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-12	29-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-12	29-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MOC-13	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-13	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	Benzene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-13	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MOC-19	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-19	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	Benzene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-19	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MOC-20	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-20	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MOC-20	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-20	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-20	30-Aug-95	Benzene	1.5	ug/l	E602
MOC-20	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-20	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-20	30-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-20	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MOC-21	29-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MOC-21	29-Aug-95	1,2,3-Trimethylbenzene	1.4	ug/l	E602
MOC-21	29-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MOC-21	29-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MOC-21	29-Aug-95	Benzene	1.7	ug/l	E602
MOC-21	29-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MOC-21	29-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MOC-21	29-Aug-95	Toluene	0.4 U	ug/l	E602
MOC-21	29-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-01	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-01	1-Sep-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-01	1-Sep-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-01	1-Sep-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-01	1-Sep-95	Benzene	0.5	ug/l	E602
MW-01	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
MW-01	1-Sep-95	Ethylbenzene	0.4 U	ug/l	E602
MW-01	1-Sep-95	Toluene	0.4 U	ug/l	E602
MW-01	1-Sep-95	Xylene (total)	0.4 U	ug/l	E602
MW-02	28-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-02	28-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-02	28-Aug-95	1,2,4-Trimethylbenzene	1.7	ug/l	E602
MW-02	28-Aug-95	1,3,5-Trimethylbenzene	1.3	ug/l	E602
MW-02	28-Aug-95	Benzene	87	ug/l	E602
MW-02	28-Aug-95	Chlorobenzene	1.9	ug/l	E602
MW-02	28-Aug-95	Ethylbenzene	7.4	ug/l	E602
MW-02	28-Aug-95	Toluene	11	ug/l	E602
MW-02	28-Aug-95	Xylene (total)	9.9	ug/l	E602
MW-03	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-03	30-Aug-95	1,2,3-Trimethylbenzene	1.4	ug/l	E602
MW-03	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-03	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-03	30-Aug-95	Benzene	0.4 U	ug/l	E602
MW-03	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-03	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-03	30-Aug-95	Toluene	0.4 U	ug/l	E602
MW-03	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-04	30-Aug-95	1,2,3,4-Tetramethylbenzene	6	ug/l	E602
MW-04	30-Aug-95	1,2,3-Trimethylbenzene	19	ug/l	E602
MW-04	30-Aug-95	1,2,4-Trimethylbenzene	12	ug/l	E602
MW-04	30-Aug-95	1,3,5-Trimethylbenzene	11	ug/l	E602
MW-04	30-Aug-95	Benzene	63	ug/l	E602
MW-04	30-Aug-95	Chlorobenzene	6.6	ug/l	E602
MW-04	30-Aug-95	Ethylbenzene	22	ug/l	E602
MW-04	30-Aug-95	Toluene	14	ug/l	E602
MW-04	30-Aug-95	Xylene (total)	27	ug/l	E602
MW-05	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-05	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-05	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-05	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-05	31-Aug-95	Benzene	4.9	ug/l	E602
MW-05	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-05	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-05	31-Aug-95	Toluene	0.5	ug/l	E602
MW-05	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-06	29-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-06	29-Aug-95	1,2,3-Trimethylbenzene	1.6	ug/l	E602
MW-06	29-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-06	29-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-06	29-Aug-95	Benzene	32	ug/l	E602
MW-06	29-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-06	29-Aug-95	Ethylbenzene	1.9	ug/l	E602
MW-06	29-Aug-95	Toluene	2.4	ug/l	E602
MW-06	29-Aug-95	Xylene (total)	2.3	ug/l	E602
MW-07	28-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-07	28-Aug-95	1,2,3-Trimethylbenzene	1.6	ug/l	E602
MW-07	28-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-07	28-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-07	28-Aug-95	Benzene	6.1	ug/l	E602
MW-07	28-Aug-95	Chlorobenzene	0.4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-07	28-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-07	28-Aug-95	Toluene	0.4 U	ug/l	E602
MW-07	28-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-08	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-08	1-Sep-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-08	1-Sep-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-08	1-Sep-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-08	1-Sep-95	Benzene	0.4 U	ug/l	E602
MW-08	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
MW-08	1-Sep-95	Ethylbenzene	0.4 U	ug/l	E602
MW-08	1-Sep-95	Toluene	0.4 U	ug/l	E602
MW-08	1-Sep-95	Xylene (total)	0.4 U	ug/l	E602
MW-09	28-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-09	28-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-09	28-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-09	28-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-09	28-Aug-95	Benzene	0.4 U	ug/l	E602
MW-09	28-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-09	28-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-09	28-Aug-95	Toluene	0.4 U	ug/l	E602
MW-09	28-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-10	28-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-10	28-Aug-95	1,2,3-Trimethylbenzene	11	ug/l	E602
MW-10	28-Aug-95	1,2,4-Trimethylbenzene	4.1	ug/l	E602
MW-10	28-Aug-95	1,3,5-Trimethylbenzene	4.8	ug/l	E602
MW-10	28-Aug-95	Benzene	23	ug/l	E602
MW-10	28-Aug-95	Chlorobenzene	1.2	ug/l	E602
MW-10	28-Aug-95	Ethylbenzene	2.5	ug/l	E602
MW-10	28-Aug-95	Toluene	5.1	ug/l	E602
MW-10	28-Aug-95	Xylene (total)	4.1	ug/l	E602
MW-11	30-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-11	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-11	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-11	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-11	30-Aug-95	Benzene	1.3	ug/l	E602
MW-11	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-11	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-11	30-Aug-95	Toluene	0.4 U	ug/l	E602
MW-11	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-111	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-111	1-Sep-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-111	1-Sep-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-111	1-Sep-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-111	1-Sep-95	Benzene	0.4 U	ug/l	E602
MW-111	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
MW-111	1-Sep-95	Ethylbenzene	0.4 U	ug/l	E602
MW-111	1-Sep-95	Toluene	0.4 U	ug/l	E602
MW-111	1-Sep-95	Xylene (total)	0.4 U	ug/l	E602
MW-112	29-Aug-95	1,2,3,4-Tetramethylbenzene	580	ug/l	E602
MW-112	29-Aug-95	1,2,3-Trimethylbenzene	650	ug/l	E602
MW-112	29-Aug-95	1,2,4-Trimethylbenzene	2600	ug/l	E602
MW-112	29-Aug-95	1,3,5-Trimethylbenzene	510	ug/l	E602
MW-112	29-Aug-95	Benzene	5000	ug/l	E602
MW-112	29-Aug-95	Chlorobenzene	29	ug/l	E602
MW-112	29-Aug-95	Ethylbenzene	2300	ug/l	E602
MW-112	29-Aug-95	Toluene	26000	ug/l	E602
MW-112	29-Aug-95	Xylene (total)	14000	ug/l	E602
MW-113	31-Aug-95	1,2,3,4-Tetramethylbenzene	8.2	ug/l	E602
MW-113	31-Aug-95	1,2,3-Trimethylbenzene	44	ug/l	E602
MW-113	31-Aug-95	1,2,4-Trimethylbenzene	210	ug/l	E602
MW-113	31-Aug-95	1,3,5-Trimethylbenzene	48	ug/l	E602
MW-113	31-Aug-95	Benzene	3000	ug/l	E602
MW-113	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-113	31-Aug-95	Ethylbenzene	200	ug/l	E602
MW-113	31-Aug-95	Toluene	2100	ug/l	E602
MW-113	31-Aug-95	Xylene (total)	860	ug/l	E602
MW-12	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-12	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-12	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-12	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-12	31-Aug-95	Benzene	0.4 U	ug/l	E602
MW-12	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-12	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-12	31-Aug-95	Toluene	0.4 U	ug/l	E602
MW-12	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-13	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-13	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-13	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-13	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-13	31-Aug-95	Benzene	0.4 U	ug/l	E602
MW-13	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-13	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-13	31-Aug-95	Toluene	0.4 U	ug/l	E602
MW-13	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-14	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-14	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-14	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-14	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-14	30-Aug-95	Benzene	0.4 U	ug/l	E602
MW-14	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-14	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-14	30-Aug-95	Toluene	0.4 U	ug/l	E602
MW-14	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-15	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-15	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-15	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-15	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-15	31-Aug-95	Benzene	0.4 U	ug/l	E602
MW-15	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-15	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-15	31-Aug-95	Toluene	0.4 U	ug/l	E602
MW-15	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-16	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-16	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-16	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-16	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-16	31-Aug-95	Benzene	0.4 U	ug/l	E602
MW-16	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-16	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-16	31-Aug-95	Toluene	0.4 U	ug/l	E602
MW-16	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-17	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-17	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-17	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-17	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-17	30-Aug-95	Benzene	0.4 U	ug/l	E602
MW-17	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602

TABLE B.6
GROUNDWATER DATA FOR VOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-17	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-17	30-Aug-95	Toluene	0.4 U	ug/l	E602
MW-17	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-18	31-Aug-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
MW-18	31-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-18	31-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-18	31-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-18	31-Aug-95	Benzene	0.4 U	ug/l	E602
MW-18	31-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-18	31-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-18	31-Aug-95	Toluene	0.4 U	ug/l	E602
MW-18	31-Aug-95	Xylene (total)	0.4 U	ug/l	E602
MW-19	30-Aug-95	1,2,3,4-Tetramethylbenzene	0.5 U	ug/l	E602
MW-19	30-Aug-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
MW-19	30-Aug-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
MW-19	30-Aug-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
MW-19	30-Aug-95	Benzene	0.4 U	ug/l	E602
MW-19	30-Aug-95	Chlorobenzene	0.4 U	ug/l	E602
MW-19	30-Aug-95	Ethylbenzene	0.4 U	ug/l	E602
MW-19	30-Aug-95	Toluene	0.4 U	ug/l	E602
MW-19	30-Aug-95	Xylene (total)	0.4 U	ug/l	E602

TABLE B.7
GROUNDWATER DATA FOR ACIDS AND PHENOLS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-02	1/95	Propanoic Acid	9.9	mg/L	RSKSOP-177
MW-02	1/95	2-Methylpropanoic Acid	0.2	mg/L	RSKSOP-177
MW-02	1/95	Trimethyl Acetic Acid	2.4	mg/L	RSKSOP-177
MW-02	1/95	Butyric Acid	6.1	mg/L	RSKSOP-177
MW-02	1/95	2-Methylbutyric Acid	0.6	mg/L	RSKSOP-177
MW-02	1/95	3-Methylbutyric Acid	0.2	mg/L	RSKSOP-177
MW-02	1/95	3,3-Dimethylbutyric Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	Pentanoic Acid	0.4	mg/L	RSKSOP-177
MW-02	1/95	2,3-Dimethylbutyric Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2-Ethylbutyric Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2-Methylpentanoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	3-Methylpentanoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	4-Methylpentanoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	Hexanoic Acid	1.7	mg/L	RSKSOP-177
MW-02	1/95	2-Methylhexanoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	Phenol	1.1	mg/L	RSKSOP-177
MW-02	1/95	Cyclopentanecarboxylic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	5-Methylhexanoic Acid	0.4	mg/L	RSKSOP-177
MW-02	1/95	o-Cresol	ND	mg/L	RSKSOP-177
MW-02	1/95	2-Ethylhexanoic Acid	0.1	mg/L	RSKSOP-177
MW-02	1/95	Heptanoic Acid	0.4	mg/L	RSKSOP-177
MW-02	1/95	m-Cresol	ND	mg/L	RSKSOP-177
MW-02	1/95	p-Cresol	1.2	mg/L	RSKSOP-177
MW-02	1/95	1-Cyclopentene-1-Carboxylic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	o-Ethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	Cyclopentaneacetic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,6-Dimethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	2,5-Dimethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	Cyclohexanecarboxylic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	3-Cyclohexene-1-Carboxylic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,4-Dimethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	3,5-Dimethylphenol & m-Ethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	Octanoic Acid	0.5	mg/L	RSKSOP-177
MW-02	1/95	2,3-Dimethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	p-Ethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	Benzoic Acid	0.6	mg/L	RSKSOP-177
MW-02	1/95	3,4-Dimethylphenol	ND	mg/L	RSKSOP-177
MW-02	1/95	m-Methylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	1-Cyclohexene-1-Carboxylic Acid	ND	mg/L	RSKSOP-177

TABLE B.7
GROUNDWATER DATA FOR ACIDS AND PHENOLS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-02	1/95	Cyclohexaneacetic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2-Phenylpropanoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	o-Methylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	Phenylacetic Acid	0.1	mg/L	RSKSOP-177
MW-02	1/95	m-Tolylacetic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	o-Tolylacetic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,6-Dimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	p-Tolylacetic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	p-Methylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	3-Phenylpropanoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,5-Dimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	Decanoic Acid	0.1	mg/L	RSKSOP-177
MW-02	1/95	2,4-Dimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	3,5-Dimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,3-Dimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	4-Ethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,4,6-Trimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	3,4-Dimethylbenzoic Acid	ND	mg/L	RSKSOP-177
MW-02	1/95	2,4,5-Trimethylbenzoic Acid	ND	mg/L	RSKSOP-177

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MOC-02	28-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Bis(2-ethylhexyl)phthalate	1 J	UG/L	SW8270
MOC-02	28-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Flourene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Phenol	0.5 U	UG/L	SW8270
MOC-02	28-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	2-Methylnaphthalene	7 J	UG/L	SW8270
MOC-10	29-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Bis(2-ethylhexyl)phthalate	1 J	UG/L	SW8270
MOC-10	29-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Flourene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MOC-10	29-Aug-95	Naphthalene	33	UG/L	SW8270
MOC-10	29-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Phenol	0.5 U	UG/L	SW8270
MOC-10	29-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Bis(2-ethylhexyl)phthalate	1 J	UG/L	SW8270
MOC-19	30-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Flourene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Phenol	0.5 U	UG/L	SW8270
MOC-19	30-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Bis(2-ethylhexyl)phthalate	0.5 U	UG/L	SW8270

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MOC-21	29-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Flourene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Phenol	0.5 U	UG/L	SW8270
MOC-21	29-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Bis(2-ethylhexyl)phthalate	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Flourene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Phenol	0.5 U	UG/L	SW8270
MW-02	28-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MW-07	28-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Bis(2-ethylhexyl)phthalate	1 J	UG/L	SW8270
MW-07	28-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Flourene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Phenol	0.5 U	UG/L	SW8270
MW-07	28-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	2-Methylphenol	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	4-Methylphenol	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Acenaphthene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Anthracene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Benzoic Acid	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Bis(2-ethylhexyl)phthalate	1 J	UG/L	SW8270
MW-111	1-Sep-95	Chrysene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Flourene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Fluoranthene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Naphthalene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Phenanthrene	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Phenol	0.5 U	UG/L	SW8270
MW-111	1-Sep-95	Pyrene	0.5 U	UG/L	SW8270
MW-112	29-Aug-95	2,4-Dichlorophenol	2 U	UG/L	SW8270
MW-112	29-Aug-95	2,4-Dimethylphenol	10 J	UG/L	SW8270
MW-112	29-Aug-95	2-Methylnaphthalene	110	UG/L	SW8270
MW-112	29-Aug-95	2-Methylphenol	46	UG/L	SW8270
MW-112	29-Aug-95	4-Methylphenol	97	UG/L	SW8270
MW-112	29-Aug-95	Acenaphthene	2 U	UG/L	SW8270

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MW-112	29-Aug-95	Anthracene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Benzo(a)anthracene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Benzo(a)pyrene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Benzo(b)fluoranthene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Benzo(g,h,i)perylene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Benzo(k)fluoranthene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Benzoic Acid	191 J	UG/L	SW8270
MW-112	29-Aug-95	Bis(2-ethylhexyl)phthalate	2 U	UG/L	SW8270
MW-112	29-Aug-95	Chrysene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Flourene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Fluoranthene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Indeno(1,2,3-cd)pyrene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Naphthalene	490	UG/L	SW8270
MW-112	29-Aug-95	Phenanthrene	2 U	UG/L	SW8270
MW-112	29-Aug-95	Phenol	24 J	UG/L	SW8270
MW-112	29-Aug-95	Pyrene	2 U	UG/L	SW8270
MW-14	30-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Bis(2-ethylhexyl)phthalate	3 J	UG/L	SW8270
MW-14	30-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Flourene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Phenol	0.5 U	UG/L	SW8270
MW-14	30-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MW-15	31-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Bis(2-ethylhexyl)phthalate	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Flourene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Phenol	0.5 U	UG/L	SW8270
MW-15	31-Aug-95	Pyrene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	2,4-Dichlorophenol	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	2,4-Dimethylphenol	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	2-Methylnaphthalene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	2-Methylphenol	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	4-Methylphenol	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Acenaphthene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Anthracene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Benzo(a)anthracene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Benzo(a)pyrene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Benzo(b)fluoranthene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Benzo(g,h,i)perylene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Benzo(k)fluoranthene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Benzoic Acid	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Bis(2-ethylhexyl)phthalate	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Chrysene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Flourene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Fluoranthene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Indeno(1,2,3-cd)pyrene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Naphthalene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Phenanthrene	0.5 U	UG/L	SW8270
MW-16	31-Aug-95	Phenol	0.5 U	UG/L	SW8270

TABLE B.8
GROUNDWATER DATA FOR SEMIVOLATILE ORGANIC COMPOUNDS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MW-16	31-Aug-95	Pyrene	0.5 U	UG/L	SW8270

TABLE B.9
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-01	1/95	CL-	20.8		mg/L	N-601
MW-01	1/95	SO4	26.9		mg/L	N-601
MW-01	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-01	1/95	NH3	0.05	U	mg/L	E350.1
MW-02	1/95	CL-	27.9		mg/L	N-601
MW-02	1/95	SO4	31.0		mg/L	N-601
MW-02	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-02	1/95	NH3	0.05	U	mg/L	E350.1
MW-02	1/95	CL-	10.9		mg/L	N-601
MW-03	1/95	SO4	27.7		mg/L	N-601
MW-03	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-03	1/95	NH3	0.05	U	mg/L	E350.1
MW-04	1/95	CL-	21.5		mg/L	N-601
MW-04	1/95	SO4	60.3		mg/L	N-601
MW-04	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-04	1/95	NH3	0.05	U	mg/L	E350.1
MW-04 Dup	1/95	CL-	--		mg/L	N-601
MW-04 Dup	1/95	SO4	--		mg/L	N-601
MW-04 Dup	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-04 Dup	1/95	NH3	--		mg/L	E350.1
MW-05	1/95	CL-	18.2		mg/L	N-601
MW-05	1/95	SO4	10.7		mg/L	N-601
MW-05	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-05	1/95	NH3	0.05	U	mg/L	E350.1
MW-111	1/95	CL-	17.9		mg/L	N-601
MW-111	1/95	SO4	44.7		mg/L	N-601
MW-111	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-111	1/95	NH3	0.05	U	mg/L	E350.1
MW-111 Dup	1/95	CL-	18.0		mg/L	N-601
MW-111 Dup	1/95	SO4	44.7		mg/L	N-601
MW-111 Dup	1/95	NO2-+NO3- (N)	--		mg/L	E353.1
MW-111 Dup	1/95	NH3	--		mg/L	E350.1
MW-112	1/95	CL-	16.0		mg/L	N-601
MW-112	1/95	SO4	10.2		mg/L	N-601
MW-112	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MW-112	1/95	NH3	0.05	U	mg/L	E350.1
MW-113	1/95	CL-	66.7		mg/L	N-601
MW-113	1/95	SO4	20.4		mg/L	N-601
MW-113	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1

TABLE B.9
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-113	1/95	NH3	0.44	U	mg/L	E350.1
MOC-02	1/95	CL-	27.8		mg/L	N-601
MOC-02	1/95	SO4	33.2		mg/L	N-601
MOC-02	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MOC-02	1/95	NH3	0.05	U	mg/L	E350.1
MOV-01-03	1/95	CL-	13.8		mg/L	N-601
MOV-01-03	1/95	SO4	1.87		mg/L	N-601
MOV-01-03	1/95	NO2-+NO3- (N)	NS		mg/L	E353.1
MOV-01-03	1/95	NH3	NS		mg/L	E350.1
MOC-03	1/95	CL-	22.0		mg/L	N-601
MOC-03	1/95	SO4	33.9		mg/L	N-601
MOC-03	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MOC-03	1/95	NH3	0.05	U	mg/L	E350.1
MOC-04	1/95	CL-	23.4		mg/L	N-601
MOC-04	1/95	SO4	31.8		mg/L	N-601
MOC-04	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MOC-04	1/95	NH3	0.05	U	mg/L	E350.1
MOC-04 Dup	1/95	CL-	--		mg/L	N-601
MOC-04 Dup	1/95	SO4	--		mg/L	N-601
MOC-04 Dup	1/95	NO2-+NO3- (N)	0.05	U	mg/L	E353.1
MOC-04 Dup	1/95	NH3	0.05	U	mg/L	E350.1
MOC-05	1/95	CL-	28.8		mg/L	N-601
MOC-05	1/95	SO4	0.05	U	mg/L	N-601
MOC-05	1/95	NO2-+NO3- (N)	0.08		mg/L	E353.1
MOC-05	1/95	NH3	0.05	U	mg/L	E350.1
MOC-07	1/95	CL-	27.6		mg/L	N-601
MOC-07	1/95	SO4	31.6		mg/L	N-601
MOC-07	1/95	NO2-+NO3- (N)	0.07		mg/L	E353.1
MOC-07	1/95	NH3	0.05	U	mg/L	E350.1
MOC-08	1/95	CL-	10.8		mg/L	N-601
MOC-08	1/95	SO4	51.0		mg/L	N-601
MOC-08	1/95	NO2-+NO3- (N)	0.07		mg/L	E353.1
MOC-08	1/95	NH3	0.05	U	mg/L	E350.1
MOC-08 Dup	1/95	CL-	10.9		mg/L	N-601
MOC-08 Dup	1/95	SO4	50.5		mg/L	N-601
MOC-08 Dup	1/95	NO2-+NO3- (N)	--		mg/L	E353.1
MOC-08 Dup	1/95	NH3	--		mg/L	E350.1
MOC-11	1/95	CL-	26.1		mg/L	N-601
MOC-11	1/95	SO4	16.7		mg/L	N-601

TABLE B.9
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOC-11	1/95	NO2-+NO3- (N)	0.08		mg/L	E353.1
MOC-11	1/95	NH3	0.05	U	mg/L	E350.1
MOV-01-3	1/95	TOC	19.7		mg/L	RSKSOP-102
MOV-01-3	1/95	TIC	37.8		mg/L	RSKSOP-102
MOC-02	1/95	TOC	2.8		mg/L	RSKSOP-102
MOC-02	1/95	TIC	23.7		mg/L	RSKSOP-102
MOC-03	1/95	TOC	3.4		mg/L	RSKSOP-102
MOC-03	1/95	TIC	17.1		mg/L	RSKSOP-102
MOC-04	1/95	TOC	3.6		mg/L	RSKSOP-102
MOC-04	1/95	TIC	28.9		mg/L	RSKSOP-102
MOC-05	1/95	TOC	15.1		mg/L	RSKSOP-102
MOC-05	1/95	TIC	21.9		mg/L	RSKSOP-102
MOC-07	1/95	TOC	3.9		mg/L	RSKSOP-102
MOC-07	1/95	TIC	20.6		mg/L	RSKSOP-102
MOC-07 Dup	1/95	TOC	3.9		mg/L	RSKSOP-102
MOC-07 Dup	1/95	TIC	20.6		mg/L	RSKSOP-102
MOC-08	1/95	TOC	3.2		mg/L	RSKSOP-102
MOC-08	1/95	TIC	24.8		mg/L	RSKSOP-102
MOC-11	1/95	TOC	6.9		mg/L	RSKSOP-102
MOC-11	1/95	TIC	30.1		mg/L	RSKSOP-102
MW-01	1/95	TOC	4.8		mg/L	RSKSOP-102
MW-01	1/95	TIC	14.2		mg/L	RSKSOP-102
MW-02	1/95	TOC	3.7		mg/L	RSKSOP-102
MW-02	1/95	TIC	43.3		mg/L	RSKSOP-102
MW-03	1/95	TOC	3.4		mg/L	RSKSOP-102
MW-03	1/95	TIC	18.6		mg/L	RSKSOP-102
MW-05	1/95	TOC	8.2		mg/L	RSKSOP-102
MW-05	1/95	TIC	38.3		mg/L	RSKSOP-102
MW-111	1/95	TOC	2.4		mg/L	RSKSOP-102
MW-111	1/95	TIC	4.6		mg/L	RSKSOP-102
MW-112	1/95	TOC	27.5		mg/L	RSKSOP-102
MW-112	1/95	TIC	28.0		mg/L	RSKSOP-102
MW-113	1/95	TOC	12.3		mg/L	RSKSOP-102
MW-113	1/95	TIC	12.2		mg/L	RSKSOP-102
MW-113 Dup	1/95	TOC	12.3		mg/L	RSKSOP-102
MW-113 Dup	1/95	TIC	11.7		mg/L	RSKSOP-102
MW-01	1/95	Methane	0.472		mg/L	RSKSOP-175 & -14
MW-01	1/95	Ethylene	ND		mg/L	RSKSOP-175 & -14
MW-02	1/95	Methane	0.744		mg/L	RSKSOP-175 & -14

TABLE B.9
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-02	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14
MW-03	1/95	Methane	1.380	mg/L	RSKSOP-175 & -14
MW-03	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14
MW-04	1/95	Methane	0.481	mg/L	RSKSOP-175 & -14
MW-04	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14
MW-05	1/95	Methane	0.585	mg/L	RSKSOP-175 & -14
MW-05	1/95	Ethylene	0.001	mg/L	RSKSOP-175 & -14
MW-111	1/95	Methane	0.115	mg/L	RSKSOP-175 & -14
MW-111	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14
MW-112	1/95	Methane	1.104	mg/L	RSKSOP-175 & -14
MW-112	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14
MW-113	1/95	Methane	0.842	mg/L	RSKSOP-175 & -14
MW-113	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14
MV-01-3	1/95	Methane	3.167	mg/L	RSKSOP-175 & -14
MV-01-3	1/95	Ethylene	ND	mg/L	RSKSOP-175 & -14

TABLE B.10
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
AS-01	29-Aug-95	Methane	0.31	MG/L	RSKSOP175
AS-01	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
AS-01	29-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
AS-02	31-Aug-95	Methane	0.42	MG/L	RSKSOP175
AS-02	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
AS-02	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-02	28-Aug-95	Carbon Dioxide	337	MG/L	CO2
MOC-02	28-Aug-95	Methane	0.57	MG/L	RSKSOP175
MOC-02	28-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-02	28-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-03	1-Sep-95	Methane	0.156	MG/L	RSKSOP175
MOC-03	1-Sep-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-03	1-Sep-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-04	1-Sep-95	Methane	0.108	MG/L	RSKSOP175
MOC-04	1-Sep-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-04	1-Sep-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-05	29-Aug-95	Methane	0.38	MG/L	RSKSOP175
MOC-05	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-05	29-Aug-95	Nitrogen, Nitrite	0.1	MG/L	E300.0
MOC-07	29-Aug-95	Methane	0.48	MG/L	RSKSOP175
MOC-07	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-07	29-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-08	28-Aug-95	Carbon Dioxide	253	MG/L	CO2
MOC-08	28-Aug-95	Methane	0.201	MG/L	RSKSOP175
MOC-08	28-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-08	28-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-10	29-Aug-95	Carbon Dioxide	293	MG/L	CO2
MOC-10	29-Aug-95	Methane	1.21	MG/L	RSKSOP175
MOC-10	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-10	29-Aug-95	Nitrogen, Nitrite	0.12	MG/L	E300.0
MOC-11	31-Aug-95	Methane	0.214	MG/L	RSKSOP175
MOC-11	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-11	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-12	29-Aug-95	Carbon Dioxide	297	MG/L	CO2
MOC-12	29-Aug-95	Methane	0.3	MG/L	RSKSOP175
MOC-12	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-12	29-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-13	30-Aug-95	Methane	0.262	MG/L	RSKSOP175
MOC-13	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-13	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0

TABLE B.10
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MOC-19	30-Aug-95	Carbon Dioxide	169	MG/L	CO2
MOC-19	30-Aug-95	Methane	0.058	MG/L	RSKSOP175
MOC-19	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-19	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-20	30-Aug-95	Methane	0.162	MG/L	RSKSOP175
MOC-20	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-20	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MOC-21	29-Aug-95	Carbon Dioxide	257	MG/L	CO2
MOC-21	29-Aug-95	Methane	0.31	MG/L	RSKSOP175
MOC-21	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MOC-21	29-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-01	1-Sep-95	Methane	0.252	MG/L	RSKSOP175
MW-01	1-Sep-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-01	1-Sep-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-02	28-Aug-95	Carbon Dioxide	319	MG/L	CO2
MW-02	28-Aug-95	Methane	0.54	MG/L	RSKSOP175
MW-02	28-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-02	28-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-03	30-Aug-95	Methane	0.31	MG/L	RSKSOP175
MW-03	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-03	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-04	30-Aug-95	Methane	0.45	MG/L	RSKSOP175
MW-04	30-Aug-95	Nitrogen, Nitrate	0.069	MG/L	E300.0
MW-04	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-05	31-Aug-95	Methane	0.47	MG/L	RSKSOP175
MW-05	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-05	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-06	29-Aug-95	Carbon Dioxide	246	MG/L	CO2
MW-06	29-Aug-95	Methane	0.162	MG/L	RSKSOP175
MW-06	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-06	29-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-07	28-Aug-95	Carbon Dioxide	348	MG/L	CO2
MW-07	28-Aug-95	Methane	0.095	MG/L	RSKSOP175
MW-07	28-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-07	28-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-08	1-Sep-95	Methane	0.072	MG/L	RSKSOP175
MW-08	1-Sep-95	Nitrogen, Nitrate	0.06	MG/L	E300.0
MW-08	1-Sep-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-09	28-Aug-95	Carbon Dioxide	315	MG/L	CO2
MW-09	28-Aug-95	Methane	0.33	MG/L	RSKSOP175
MW-09	28-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0

TABLE B.10
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MW-09	28-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-10	28-Aug-95	Carbon Dioxide	253	MG/L	CO2
MW-10	28-Aug-95	Methane	0.85	MG/L	RSKSOP175
MW-10	28-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-10	28-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-11	30-Aug-95	Methane	0.59	MG/L	RSKSOP175
MW-11	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-11	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-111	1-Sep-95	Carbon Dioxide	235	MG/L	CO2
MW-111	1-Sep-95	Methane	0.061	MG/L	RSKSOP175
MW-111	1-Sep-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-111	1-Sep-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-112	29-Aug-95	Carbon Dioxide	290	MG/L	CO2
MW-112	29-Aug-95	Methane	0.66	MG/L	RSKSOP175
MW-112	29-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-112	29-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-113	31-Aug-95	Methane	0.95	MG/L	RSKSOP175
MW-113	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-113	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-12	31-Aug-95	Methane	0.35	MG/L	RSKSOP175
MW-12	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-12	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-13	31-Aug-95	Methane	0.128	MG/L	RSKSOP175
MW-13	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-13	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-14	30-Aug-95	Carbon Dioxide	235	MG/L	CO2
MW-14	30-Aug-95	Methane	0.079	MG/L	RSKSOP175
MW-14	30-Aug-95	Nitrogen, Nitrate	0.082	MG/L	E300.0
MW-14	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-15	31-Aug-95	Carbon Dioxide	136	MG/L	CO2
MW-15	31-Aug-95	Methane	0.57	MG/L	RSKSOP175
MW-15	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-15	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-16	31-Aug-95	Carbon Dioxide	260	MG/L	CO2
MW-16	31-Aug-95	Methane	0.101	MG/L	RSKSOP175
MW-16	31-Aug-95	Nitrogen, Nitrate	0.066	MG/L	E300.0
MW-16	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-17	30-Aug-95	Methane	0.037	MG/L	RSKSOP175
MW-17	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-17	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-18	31-Aug-95	Carbon Dioxide	235	MG/L	CO2

TABLE B.10
GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
MW-18	31-Aug-95	Methane	0.098	MG/L	RSKSOP175
MW-18	31-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-18	31-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0
MW-19	30-Aug-95	Methane	0.1	MG/L	RSKSOP175
MW-19	30-Aug-95	Nitrogen, Nitrate	0.056 U	MG/L	E300.0
MW-19	30-Aug-95	Nitrogen, Nitrite	0.1 U	MG/L	E300.0

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
MOC-02	28-Aug-95	Ferrous Iron	2.8	mg/l	H8146
		Total Iron	2.8	mg/l	
		Carbon Dioxide	170	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	36.12	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	27.60	Deg C	FTEMP
		Specific Conductance	359.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.42	mg/l	FDO
		Redox Potential	-227.00	pE units	FREDOX
MOC-03	1-Sep-95	Ferrous Iron	1.5	mg/l	H8146
		Total Iron	1.52	mg/l	
		Carbon Dioxide	170	mg/l	H8223
		Alkalinity	100	mg/l	H8221
		Sulfate	34.55	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	29.10	Deg C	FTEMP
		pH	5.88	pH units	FPH
		Specific Conductance	138.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.11	mg/l	FDO
		Redox Potential	-256.00	pE units	FREDOX
MOC-04	1-Sep-95	Ferrous Iron	1.29	mg/l	H8146
		Total Iron	1.33	mg/l	
		Carbon Dioxide	155	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	30.91	mg/l	H8051
		Sulfide(S)	0.4	mg/l	H8131
		Temperature	30.10	Deg C	FTEMP
		pH	6.05	pH units	FPH
		Specific Conductance	192.00	mmhos/cm	FCOND
		Dissolved Oxygen	1.30	mg/l	FDO
		Redox Potential	-239.00	pE units	FREDOX
MOC-05	29-Aug-95	Ferrous Iron	3.57	mg/l	H8146
		Total Iron	3.54	mg/l	
		Carbon Dioxide	265	mg/l	H8223
		Alkalinity	100	mg/l	H8221
		Sulfate	0.86	mg/l	H8051
		Sulfide(S)	5	mg/l	H8131
		Temperature	25.20	Deg C	FTEMP

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		pH	5.47	pH units	FPH
		Specific Conductance	186.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.38	mg/l	FDO
		Redox Potential	-244.00	pE units	FREDOX
MOC-07	29-Aug-95	Ferrous Iron	2.05	mg/l	H8146
		Total Iron	1.97	mg/l	
		Carbon Dioxide	280	mg/l	H8223
		Alkalinity	100	mg/l	H8221
		Sulfate	32.44	mg/l	H8051
		Sulfide(S)	0.3	mg/l	H8131
		Temperature	27.70	Deg C	FTEMP
		pH	5.55	pH units	FPH
		Specific Conductance	211.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.50	mg/l	FDO
		Redox Potential	-228.00	pE units	FREDOX
MOC-08	28-Aug-95	Ferrous Iron	5.85	mg/l	H8146
		Total Iron	7.5	mg/l	
		Carbon Dioxide	195	mg/l	H8223
		Alkalinity	100	mg/l	H8221
		Sulfate	44.79	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	28.10	Deg C	FTEMP
		pH	6.04	pH units	FPH
		Specific Conductance	290.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.40	mg/l	FDO
MOC-10	29-Aug-95	Ferrous Iron	1.04	mg/l	H8146
		Total Iron	1	mg/l	
		Carbon Dioxide	215	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	29.38	mg/l	H8051
		Sulfide(S)	0.8	mg/l	H8131
		Temperature	28.40	Deg C	FTEMP
		pH	5.87	pH units	FPH
		Specific Conductance	290.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.97	mg/l	FDO
		Redox Potential	-265.00	pE units	FREDOX
MOC-11	31-Aug-95	Ferrous Iron	1.39	mg/l	H8146
		Total Iron	1.4	mg/l	
		Carbon Dioxide	185	mg/l	H8223

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Alkalinity	100	mg/l	H8221
		Sulfate	17.66	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	28.70	Deg C	FTEMP
		pH	5.81	pH units	FPH
		Specific Conductance	176.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.28	mg/l	FDO
		Redox Potential	-200.00	pE units	FREDOX
MOC-12	29-Aug-95	Ferrous Iron	0.54	mg/l	H8146
		Total Iron	0.56	mg/l	
		Carbon Dioxide	220	mg/l	H8223
		Alkalinity	160	mg/l	H8221
		Sulfate	38.23	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.30	Deg C	FTEMP
		pH	5.93	pH units	FPH
		Specific Conductance	303.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.79	mg/l	FDO
		Redox Potential	-178.00	pE units	FREDOX
MOC-13	30-Aug-95	Ferrous Iron	1.12	mg/l	H8146
		Total Iron	0.45	mg/l	
		Carbon Dioxide	105	mg/l	H8223
		Alkalinity	240	mg/l	H8221
		Sulfate	22.2	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	27.40	Deg C	FTEMP
		pH	6.46	pH units	FPH
		Specific Conductance	345.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.43	mg/l	FDO
		Redox Potential	-210.00	pE units	FREDOX
MOC-19	30-Aug-95	Ferrous Iron	0.98	mg/l	H8146
		Total Iron	1.05	mg/l	
		Carbon Dioxide	140	mg/l	H8223
		Alkalinity	100	mg/l	H8221
		Sulfate	24.35	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	24.90	Deg C	FTEMP
		pH	6.03	pH units	FPH
		Specific Conductance	75.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.34	mg/l	FDO

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Redox Potential	-108.00	pE units	FREDOX
MOC-20	30-Aug-95	Ferrous Iron	0.82	mg/l	H8146
		Total Iron	0.8	mg/l	
		Carbon Dioxide	200	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	39.19	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.10	Deg C	FTEMP
		pH	5.76	pH units	FPH
		Specific Conductance	200.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.35	mg/l	FDO
		Redox Potential	-155.00	pE units	FREDOX
MOC-21	29-Aug-95	Ferrous Iron	1.58	mg/l	H8146
		Total Iron	1.62	mg/l	
		Carbon Dioxide	190	mg/l	H8223
		Alkalinity	160	mg/l	H8221
		Sulfate	36.84	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	27.20	Deg C	FTEMP
		pH	5.95	pH units	FPH
		Specific Conductance	142.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.20	mg/l	FDO
		Redox Potential	-231.00	pE units	FREDOX
MW-01	1-Sep-95	Ferrous Iron	3.81	mg/l	H8146
		Total Iron	3.94	mg/l	
		Carbon Dioxide	170	mg/l	H8223
		Alkalinity	100	mg/l	H8221
		Sulfate	29.19	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	27.70	Deg C	FTEMP
		pH	5.68	pH units	FPH
		Specific Conductance	281.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.30	mg/l	FDO
		Redox Potential	-193.00	pE units	FREDOX
MW-02	28-Aug-95	Ferrous Iron	17.7	mg/l	H8146
		Total Iron	20.75	mg/l	
		Carbon Dioxide	195	mg/l	H8223
		Alkalinity	130	mg/l	H8221
		Sulfate	121.75	mg/l	H8051

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Sulfide(S)	0	mg/l	H8131
		Temperature	28.30	Deg C	FTEMP
		Specific Conductance	445.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.30	mg/l	FDO
		Redox Potential	-177.00	pE units	FREDOX
MW-03	30-Aug-95	Ferrous Iron	1.51	mg/l	H8146
		Total Iron	1.73	mg/l	
		Carbon Dioxide	154	mg/l	H8223
		Alkalinity	80	mg/l	H8221
		Sulfate	27.27	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.50	Deg C	FTEMP
		pH	5.87	pH units	FPH
		Specific Conductance	76.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.10	mg/l	FDO
		Redox Potential	-205.00	pE units	FREDOX
MW-04	30-Aug-95	Ferrous Iron	1.29	mg/l	H8146
		Total Iron	1.23	mg/l	
		Carbon Dioxide	190	mg/l	H8223
		Alkalinity	160	mg/l	H8221
		Sulfate	48.37	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.50	Deg C	FTEMP
		pH	6.02	pH units	FPH
		Specific Conductance	283.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.29	mg/l	FDO
		Redox Potential	-180.00	pE units	FREDOX
MW-05	31-Aug-95	Ferrous Iron	0.04	mg/l	H8146
		Total Iron	1.44	mg/l	
		Carbon Dioxide	140	mg/l	H8223
		Alkalinity	220	mg/l	H8221
		Sulfate	1	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.50	Deg C	FTEMP
		pH	6.24	pH units	FPH
		Specific Conductance	293.00	mmhos/cm	FCOND
		Dissolved Oxygen	1.10	mg/l	FDO
		Redox Potential	-14.00	pE units	FREDOX
MW-06	29-Aug-95	Ferrous Iron	3.31	mg/l	H8146

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Total Iron	3.2	mg/l	
		Carbon Dioxide	184	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	36.12	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.30	Deg C	FTEMP
		pH	5.97	pH units	FPH
		Specific Conductance	130.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.43	mg/l	FDO
		Redox Potential	-204.00	pE units	FREDOX
MW-07	28-Aug-95	Ferrous Iron	4.2	mg/l	H8146
		Total Iron	4.13	mg/l	
		Carbon Dioxide	210	mg/l	H8223
		Alkalinity	80	mg/l	H8221
		Sulfate	44.55	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	27.50	Deg C	FTEMP
		Specific Conductance	363.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.68	mg/l	FDO
MW-08	1-Sep-95	Ferrous Iron	0.05	mg/l	H8146
		Total Iron	0.03	mg/l	
		Carbon Dioxide	100	mg/l	H8223
		Alkalinity	240	mg/l	H8221
		Sulfate	62.8	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
MW-09	28-Aug-95	Ferrous Iron	2.54	mg/l	H8146
		Total Iron	2.6	mg/l	
		Carbon Dioxide	215	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	34.02	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	29.00	Deg C	FTEMP
		Specific Conductance	293.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.30	mg/l	FDO
		Redox Potential	-206.00	pE units	FREDOX
MW-10	28-Aug-95	Ferrous Iron	1.7	mg/l	H8146
		Total Iron	1.83	mg/l	
		Carbon Dioxide	155	mg/l	H8223
		Alkalinity	80	mg/l	H8221

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Sulfate	27.27	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	28.00	Deg C	FTEMP
		Specific Conductance	253.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.41	mg/l	FDO
		Redox Potential	-175.00	pE units	FREDOX
MW-11	30-Aug-95	Ferrous Iron	0.82	mg/l	H8146
		Total Iron	0.78	mg/l	
		Carbon Dioxide	181	mg/l	H8223
		Alkalinity	120	mg/l	H8221
		Sulfate	16.46	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	25.30	Deg C	FTEMP
		pH	6.16	pH units	FPH
		Specific Conductance	142.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.19	mg/l	FDO
		Redox Potential	-227.00	pE units	FREDOX
MW-12	31-Aug-95	Ferrous Iron	0.68	mg/l	H8146
		Total Iron	0.59	mg/l	
		Carbon Dioxide	54	mg/l	H8223
		Alkalinity	180	mg/l	H8221
		Sulfate	5.79	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	23.60	Deg C	FTEMP
		pH	6.87	pH units	FPH
		Specific Conductance	281.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.09	mg/l	FDO
		Redox Potential	-19.00	pE units	FREDOX
MW-13	31-Aug-95	Ferrous Iron	0.72	mg/l	H8146
		Total Iron	0.74	mg/l	
		Carbon Dioxide	160	mg/l	H8223
		Alkalinity	60	mg/l	H8221
		Sulfate	19.19	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	27.50	Deg C	FTEMP
		pH	5.11	pH units	FPH
		Specific Conductance	72.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.20	mg/l	FDO
		Redox Potential	-185.00	pE units	FREDOX

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
MW-14	30-Aug-95	Ferrous Iron	0.61	mg/l	H8146
		Total Iron	0.63	mg/l	
		Carbon Dioxide	160	mg/l	H8223
		Alkalinity	160	mg/l	H8221
		Sulfate	48.9	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	28.60	Deg C	FTEMP
		pH	6.16	pH units	FPH
		Specific Conductance	217.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.52	mg/l	FDO
		Redox Potential	67.00	pE units	FREDOX
MW-15	31-Aug-95	Ferrous Iron	0.93	mg/l	H8146
		Total Iron	1.31	mg/l	
		Carbon Dioxide	36	mg/l	H8223
		Alkalinity	180	mg/l	H8221
		Sulfate	22.63	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	24.10	Deg C	FTEMP
		pH	7.39	pH units	FPH
		Specific Conductance	140.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.01	mg/l	FDO
		Redox Potential	-199.00	pE units	FREDOX
MW-16	31-Aug-95	Ferrous Iron	1.17	mg/l	H8146
		Total Iron	1.18	mg/l	
		Carbon Dioxide	106	mg/l	H8223
		Alkalinity	220	mg/l	H8221
		Sulfate	6.89	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	22.10	Deg C	FTEMP
		pH	6.57	pH units	FPH
		Specific Conductance	374.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.20	mg/l	FDO
		Redox Potential	4.00	pE units	FREDOX
MW-17	30-Aug-95	Ferrous Iron	0.64	mg/l	H8146
		Total Iron	0.45	mg/l	
		Carbon Dioxide	120	mg/l	H8223
		Alkalinity	200	mg/l	H8221
		Sulfate	44.16	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	24.10	Deg C	FTEMP

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		pH	6.53	pH units	FPH
		Specific Conductance	373.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.42	mg/l	FDO
		Redox Potential	58.00	pE units	FREDOX
MW-18	31-Aug-95	Ferrous Iron	0.99	mg/l	H8146
		Total Iron	0.81	mg/l	
		Carbon Dioxide	56	mg/l	H8223
		Alkalinity	240	mg/l	H8221
		Sulfate	25.8	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	22.80	Deg C	FTEMP
		pH	6.84	pH units	FPH
		Specific Conductance	396.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.18	mg/l	FDO
		Redox Potential	-39.00	pE units	FREDOX
MW-19	30-Aug-95	Ferrous Iron	1.18	mg/l	H8146
		Total Iron	1.35	mg/l	
		Carbon Dioxide	150	mg/l	H8223
		Alkalinity	280	mg/l	H8221
		Sulfate	37.56	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	28.50	Deg C	FTEMP
		pH	6.56	pH units	FPH
		Specific Conductance	383.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.15	mg/l	FDO
		Redox Potential	-45.00	pE units	FREDOX
MW-111	1-Sep-95	Ferrous Iron	2.48	mg/l	H8146
		Total Iron	2.43	mg/l	
		Carbon Dioxide	180	mg/l	H8223
		Alkalinity	40	mg/l	H8221
		Sulfate	43.11	mg/l	H8051
		Sulfide(S)	0.2	mg/l	H8131
		Temperature	25.70	Deg C	FTEMP
		pH	5.42	pH units	FPH
		Specific Conductance	171.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.16	mg/l	FDO
		Redox Potential	-136.00	pE units	FREDOX
MW-112	29-Aug-95	Ferrous Iron	9.53	mg/l	H8146
		Total Iron	9.02	mg/l	

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Carbon Dioxide	230	mg/l	H8223
		Alkalinity	140	mg/l	H8221
		Sulfate	8.66	mg/l	H8051
		Sulfide(S)	1	mg/l	H8131
		Temperature	27.00	Deg C	FTEMP
		pH	5.80	pH units	FPH
		Specific Conductance	218.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.05	mg/l	FDO
		Redox Potential	-260.00	pE units	FREDOX
MW-113	31-Aug-95	Ferrous Iron	3.09	mg/l	H8146
		Total Iron	3.33	mg/l	
		Carbon Dioxide	100	mg/l	H8223
		Alkalinity	80	mg/l	H8221
		Sulfate	6.56	mg/l	H8051
		Sulfide(S)	0.5	mg/l	H8131
		Temperature	26.30	Deg C	FTEMP
		pH	5.88	pH units	FPH
		Specific Conductance	123.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.10	mg/l	FDO
		Redox Potential	-259.00	pE units	FREDOX
AS-01	29-Aug-95	Ferrous Iron	2.26	mg/l	H8146
		Total Iron	2.14	mg/l	
		Carbon Dioxide	138	mg/l	H8223
		Alkalinity	200	mg/l	H8221
		Sulfate	34.55	mg/l	H8051
		Sulfide(S)	0	mg/l	H8131
		Temperature	26.50	Deg C	FTEMP
		pH	6.28	pH units	FPH
		Specific Conductance	374.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.06	mg/l	FDO
		Redox Potential	-210.00	pE units	FREDOX
AS-02	31-Aug-95	Ferrous Iron	0.28	mg/l	H8146
		Total Iron	0.28	mg/l	
		Carbon Dioxide	200	mg/l	H8223
		Alkalinity	160	mg/l	H8221
		Sulfate	20.81	mg/l	H8051
		Sulfide(S)	1	mg/l	H8131
		Temperature	26.30	Deg C	FTEMP
		pH	5.97	pH units	FPH
		Specific Conductance	260.00	mmhos/cm	FCOND

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Dissolved Oxygen	0.25	mg/l	FDO
		Redox Potential	-288.00	pE units	FREDOX
MOC-02	16-Jan-95	Ferrous Iron	4	mg/l	H8146
		Total Iron	3.46	mg/l	
		Carbon Dioxide	314	mg/l	H8223
		Alkalinity	75	mg/l	H8221
		Sulfate	33.2	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	22.10	Deg C	FTEMP
		pH	5.80	pH units	FPH
		Specific Conductance	361.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.09	mg/l	FDO
		Redox Potential	-224.00	pE units	FREDOX
MOC-03	16-Jan-95	Ferrous Iron	3	mg/l	H8146
		Total Iron	2.11	mg/l	
		Carbon Dioxide	260	mg/l	H8223
		Alkalinity	52	mg/l	H8221
		Sulfate	33.9	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	22.40	Deg C	FTEMP
		pH	5.80	pH units	FPH
		Specific Conductance	295.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.06	mg/l	FDO
		Redox Potential	-296.00	pE units	FREDOX
MOC-04	17-Jan-95	Ferrous Iron	3.6	mg/l	H8146
		Total Iron	3.29	mg/l	
		Carbon Dioxide	198	mg/l	H8223
		Alkalinity	65	mg/l	H8221
		Sulfate	31.8	mg/l	H8051
		Sulfide(S)	0.5	mg/l	H8131
		Temperature	14.40	Deg C	FTEMP
		pH	5.90	pH units	FPH
		Specific Conductance	311.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.38	mg/l	FDO
		Redox Potential	-234.00	pE units	FREDOX
MOC-05	17-Jan-95	Ferrous Iron	8.1	mg/l	H8146
		Carbon Dioxide	388	mg/l	H8223
		Alkalinity	60	mg/l	H8221
		Sulfate	0.5	mg/l	H8051

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Sulfide(S)	10	mg/l	H8131
		Temperature	20.00	Deg C	FTEMP
		pH	5.60	pH units	FPH
		Specific Conductance	201.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.09	mg/l	FDO
		Redox Potential	-244.00	pE units	FREDOX
MOC-07	16-Jan-95	Ferrous Iron	4.6	mg/l	H8146
		Total Iron	4.24	mg/l	
		Carbon Dioxide	430	mg/l	H8223
		Alkalinity	43	mg/l	H8221
		Sulfate	31.6	mg/l	H8051
		Sulfide(S)	2	mg/l	H8131
		Temperature	21.20	Deg C	FTEMP
		pH	5.50	pH units	FPH
		Specific Conductance	273.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.27	mg/l	FDO
		Redox Potential	-258.00	pE units	FREDOX
MOC-08	16-Jan-95	Ferrous Iron	2	mg/l	H8146
		Total Iron	11.1	mg/l	
		Carbon Dioxide	320	mg/l	H8223
		Alkalinity	80	mg/l	H8221
		Sulfate	51	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	21.00	Deg C	FTEMP
		pH	5.90	pH units	FPH
		Specific Conductance	325.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.15	mg/l	FDO
		Redox Potential	-299.00	pE units	FREDOX
MOC-10	17-Jan-95	Temperature	20.30	Deg C	FTEMP
		pH	5.83	pH units	FPH
		Specific Conductance	295.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.09	mg/l	FDO
		Redox Potential	-248.00	pE units	FREDOX
MOC-11	17-Jan-95	Ferrous Iron	2.9	mg/l	H8146
		Total Iron	2.44	mg/l	
		Carbon Dioxide	284	mg/l	H8223
		Alkalinity	79	mg/l	H8221
		Sulfate	16.7	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Temperature	20.40	Deg C	FTEMP
		pH	5.80	pH units	FPH
		Specific Conductance	295.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.10	mg/l	FDO
		Redox Potential	-253.00	pE units	FREDOX
MOV-01-03	17-Jan-95	Ferrous Iron	6.8	mg/l	H8146
		Total Iron	5.33	mg/l	
		Carbon Dioxide	340	mg/l	H8223
		Alkalinity	116	mg/l	H8221
		Sulfate	1.87	mg/l	H8051
		Sulfide(S)	10	mg/l	H8131
		Temperature	15.50	Deg C	FTEMP
		pH	6.10	pH units	FPH
		Specific Conductance	310.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.08	mg/l	FDO
		Redox Potential	-253.00	pE units	FREDOX
MW-01	13-Jan-95	Ferrous Iron	3.1	mg/l	H8146
		Total Iron	2.71	mg/l	
		Carbon Dioxide	284	mg/l	H8223
		Alkalinity	42	mg/l	H8221
		Sulfate	26.9	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	21.50	Deg C	FTEMP
		pH	5.63	pH units	FPH
		Specific Conductance	254.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.34	mg/l	FDO
		Redox Potential	-180.00	pE units	FREDOX
MW-02	13-Jan-95	Ferrous Iron	5.6	mg/l	H8146
		Total Iron	5.04	mg/l	
		Carbon Dioxide	340	mg/l	H8223
		Alkalinity	159	mg/l	H8221
		Sulfate	31	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	22.10	Deg C	FTEMP
		pH	6.09	pH units	FPH
		Specific Conductance	488.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.15	mg/l	FDO
		Redox Potential	-207.00	pE units	FREDOX
MW-03	14-Jan-95	Ferrous Iron	1.5	mg/l	H8146

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Total Iron	1.41	mg/l	
		Carbon Dioxide	204	mg/l	H8223
		Alkalinity	80	mg/l	H8221
		Sulfate	27.7	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	18.70	Deg C	FTEMP
		pH	5.82	pH units	FPH
		Specific Conductance	241.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.22	mg/l	FDO
		Redox Potential	-163.00	pE units	FREDOX
MW-04	14-Jan-95	Ferrous Iron	2.9	mg/l	H8146
		Total Iron	2.48	mg/l	
		Carbon Dioxide	250	mg/l	H8223
		Alkalinity	127	mg/l	H8221
		Sulfate	60.3	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	20.20	Deg C	FTEMP
		pH	6.10	pH units	FPH
		Specific Conductance	433.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.07	mg/l	FDO
		Redox Potential	-183.00	pE units	FREDOX
MW-05	13-Jan-95	Ferrous Iron	4.5	mg/l	H8146
		Total Iron	4.31	mg/l	
		Carbon Dioxide	280	mg/l	H8223
		Alkalinity	143	mg/l	H8221
		Sulfate	10.7	mg/l	H8051
		Sulfide(S)	0.1	mg/l	H8131
		Temperature	18.60	Deg C	FTEMP
		pH	6.11	pH units	FPH
		Specific Conductance	363.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.09	mg/l	FDO
		Redox Potential	-160.00	pE units	FREDOX
MW-111	13-Jan-95	Ferrous Iron	2.3	mg/l	H8146
		Total Iron	2.3	mg/l	
		Carbon Dioxide	320	mg/l	H8223
		Alkalinity	15	mg/l	H8221
		Sulfate	44.7	mg/l	H8051
		Sulfide(S)	0.5	mg/l	H8131
		Temperature	19.60	Deg C	FTEMP
		pH	5.28	pH units	FPH

TABLE B.11
FIELD GROUNDWATER DATA FOR GEOCHEMICAL INDICATORS
JANUARY AND AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Method
		Specific Conductance	224.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.11	mg/l	FDO
		Redox Potential	-184.00	pE units	FREDOX
MW-112	14-Jan-95	Ferrous Iron	6.8	mg/l	H8146
		Total Iron	5.79	mg/l	
		Carbon Dioxide	340	mg/l	H8223
		Alkalinity	70	mg/l	H8221
		Sulfate	10.2	mg/l	H8051
		Sulfide(S)	5	mg/l	H8131
		Temperature	18.40	Deg C	FTEMP
		pH	5.44	pH units	FPH
		Specific Conductance	198.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.01	mg/l	FDO
		Redox Potential	-237.00	pE units	FREDOX
MW-113	13-Jan-95	Ferrous Iron	7.3	mg/l	H8146
		Total Iron	7.33	mg/l	
		Carbon Dioxide	280	mg/l	H8223
		Alkalinity	70	mg/l	H8221
		Sulfate	20.4	mg/l	H8051
		Sulfide(S)	5	mg/l	H8131
		Temperature	18.20	Deg C	FTEMP
		pH	5.81	pH units	FPH
		Specific Conductance	404.00	mmhos/cm	FCOND
		Dissolved Oxygen	0.14	mg/l	FDO
		Redox Potential	-223.00	pE units	FREDOX

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-113	1/95	Na-1	29.4		mg/L	ICAP
MW-113	1/95	K	1.4	U	mg/L	ICAP
MW-113	1/95	Ca	25.3		mg/L	ICAP
MW-113	1/95	Mg	8.57		mg/L	ICAP
MW-113	1/95	Fe	7.33		mg/L	ICAP
MW-113	1/95	Mn	0.0146		mg/L	ICAP
MW-113	1/95	Co	0.0065	U	mg/L	ICAP
MW-113	1/95	Mo	0.0060	U	mg/L	ICAP
MW-113	1/95	Al	0.013		mg/L	ICAP
MW-113	1/95	As	0.031	U	mg/L	ICAP
MW-113	1/95	Se	0.032	U	mg/L	ICAP
MW-113	1/95	Cd	0.0021	U	mg/L	ICAP
MW-113	1/95	Be	0.0007	U	mg/L	ICAP
MW-113	1/95	Cu	0.049	U	mg/L	ICAP
MW-113	1/95	Cr	0.0018	U	mg/L	ICAP
MW-113	1/95	Ni	0.0071	U	mg/L	ICAP
MW-113	1/95	Zn	0.0060	U	mg/L	ICAP
MW-113	1/95	Ag	0.015	U	mg/L	ICAP
MW-113	1/95	Tl	0.0093	U	mg/L	ICAP
MW-113	1/95	Pb	0.033	U	mg/L	ICAP
MW-113	1/95	Li	0.24	U	mg/L	ICAP
MW-113	1/95	Sr	0.171		mg/L	ICAP
MW-113	1/95	V	0.033	U	mg/L	ICAP
MW-113	1/95	Ba	0.0784		mg/L	ICAP
MW-113	1/95	B	0.057		mg/L	ICAP
MW-113	1/95	Ti	0.042	U	mg/L	ICAP
MOV-01-3	1/95	Na-1	16.0		mg/L	ICAP
MOV-01-3	1/95	K	1.4	U	mg/L	ICAP
MOV-01-3	1/95	Ca	35.5		mg/L	ICAP
MOV-01-3	1/95	Mg	5.10		mg/L	ICAP
MOV-01-3	1/95	Fe	5.33		mg/L	ICAP
MOV-01-3	1/95	Mn	0.0604		mg/L	ICAP
MOV-01-3	1/95	Co	0.0065	U	mg/L	ICAP
MOV-01-3	1/95	Mo	0.0060	U	mg/L	ICAP
MOV-01-3	1/95	Al	0.11	U	mg/L	ICAP
MOV-01-3	1/95	As	0.031	U	mg/L	ICAP
MOV-01-3	1/95	Se	0.032	U	mg/L	ICAP
MOV-01-3	1/95	Cd	0.0021	U	mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOV-01-3	1/95	Be	0.0007	U	mg/L	ICAP
MOV-01-3	1/95	Cu	0.127		mg/L	ICAP
MOV-01-3	1/95	Cr	0.0018	U	mg/L	ICAP
MOV-01-3	1/95	Ni	0.0071	U	mg/L	ICAP
MOV-01-3	1/95	Zn	0.134		mg/L	ICAP
MOV-01-3	1/95	Ag	0.015	U	mg/L	ICAP
MOV-01-3	1/95	Tl	0.0098	U	mg/L	ICAP
MOV-01-3	1/95	Pb	0.033	U	mg/L	ICAP
MOV-01-3	1/95	Li	0.24	U	mg/L	ICAP
MOV-01-3	1/95	Sr	0.169		mg/L	ICAP
MOV-01-3	1/95	V	0.033	U	mg/L	ICAP
MOV-01-3	1/95	Ba	0.0564		mg/L	ICAP
MOV-01-3	1/95	B	0.083		mg/L	ICAP
MOV-01-3	1/95	Ti	0.042	U	mg/L	ICAP
MW-05	1/95	Na-1	32.3		mg/L	ICAP
MW-05	1/95	K	1.5		mg/L	ICAP
MW-05	1/95	Ca	38.3		mg/L	ICAP
MW-05	1/95	Mg	2.75		mg/L	ICAP
MW-05	1/95	Fe	4.31		mg/L	ICAP
MW-05	1/95	Mn	0.0277		mg/L	ICAP
MW-05	1/95	Co	0.0065	U	mg/L	ICAP
MW-05	1/95	Mo	0.0060	U	mg/L	ICAP
MW-05	1/95	Al	0.12		mg/L	ICAP
MW-05	1/95	As	0.031	U	mg/L	ICAP
MW-05	1/95	Se	0.032	U	mg/L	ICAP
MW-05	1/95	Cd	0.0025		mg/L	ICAP
MW-05	1/95	Be	0.0007	U	mg/L	ICAP
MW-05	1/95	Cu	0.049	U	mg/L	ICAP
MW-05	1/95	Cr	0.0018		mg/L	ICAP
MW-05	1/95	Ni	0.0075		mg/L	ICAP
MW-05	1/95	Zn	0.0203		mg/L	ICAP
MW-05	1/95	Ag	0.019		mg/L	ICAP
MW-05	1/95	Tl	0.0092	U	mg/L	ICAP
MW-05	1/95	Pb	0.033	U	mg/L	ICAP
MW-05	1/95	Li	0.24	U	mg/L	ICAP
MW-05	1/95	Sr	0.198		mg/L	ICAP
MW-05	1/95	V	0.033	U	mg/L	ICAP
MW-05	1/95	Ba	0.0385		mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-05	1/95	B	0.350		mg/L	ICAP
MW-05	1/95	Ti	0.042	U	mg/L	ICAP
MW-111	1/95	Na-1	16.4		mg/L	ICAP
MW-111	1/95	K	19.0		mg/L	ICAP
MW-111	1/95	Ca	18.8		mg/L	ICAP
MW-111	1/95	Mg	1.90		mg/L	ICAP
MW-111	1/95	Fe	2.30		mg/L	ICAP
MW-111	1/95	Mn	0.0287		mg/L	ICAP
MW-111	1/95	Co	0.0065	U	mg/L	ICAP
MW-111	1/95	Mo	0.0060	U	mg/L	ICAP
MW-111	1/95	Al	0.11	U	mg/L	ICAP
MW-111	1/95	As	0.031	U	mg/L	ICAP
MW-111	1/95	Se	0.032	U	mg/L	ICAP
MW-111	1/95	Cd	0.0021	U	mg/L	ICAP
MW-111	1/95	Be	0.0007	U	mg/L	ICAP
MW-111	1/95	Cu	0.049	U	mg/L	ICAP
MW-111	1/95	Cr	0.0018	U	mg/L	ICAP
MW-111	1/95	Ni	0.0071	U	mg/L	ICAP
MW-111	1/95	Zn	0.0215		mg/L	ICAP
MW-111	1/95	Ag	0.015	U	mg/L	ICAP
MW-111	1/95	Tl	0.0097	U	mg/L	ICAP
MW-111	1/95	Pb	0.033	U	mg/L	ICAP
MW-111	1/95	Li	0.24	U	mg/L	ICAP
MW-111	1/95	Sr	0.131		mg/L	ICAP
MW-111	1/95	V	0.033	U	mg/L	ICAP
MW-111	1/95	Ba	0.0961		mg/L	ICAP
MW-111	1/95	B	0.067		mg/L	ICAP
MW-111	1/95	Ti	0.042	U	mg/L	ICAP
MW-04	1/95	Na-1	15.4		mg/L	ICAP
MW-04	1/95	K	1.4	U	mg/L	ICAP
MW-04	1/95	Ca	64.5		mg/L	ICAP
MW-04	1/95	Mg	5.08		mg/L	ICAP
MW-04	1/95	Fe	2.48		mg/L	ICAP
MW-04	1/95	Mn	0.133		mg/L	ICAP
MW-04	1/95	Co	0.0065	U	mg/L	ICAP
MW-04	1/95	Mo	0.0060	U	mg/L	ICAP
MW-04	1/95	Al	0.14		mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-04	1/95	As	0.031	U	mg/L	ICAP
MW-04	1/95	Se	0.032	U	mg/L	ICAP
MW-04	1/95	Cd	0.0038		mg/L	ICAP
MW-04	1/95	Be	0.0008	U	mg/L	ICAP
MW-04	1/95	Cu	0.049	U	mg/L	ICAP
MW-04	1/95	Cr	0.0018	U	mg/L	ICAP
MW-04	1/95	Ni	0.0117		mg/L	ICAP
MW-04	1/95	Zn	0.0184		mg/L	ICAP
MW-04	1/95	Ag	0.015	U	mg/L	ICAP
MW-04	1/95	Tl	0.0094	U	mg/L	ICAP
MW-04	1/95	Pb	0.033	U	mg/L	ICAP
MW-04	1/95	Li	0.24	U	mg/L	ICAP
MW-04	1/95	Sr	0.341		mg/L	ICAP
MW-04	1/95	V	0.033	U	mg/L	ICAP
MW-04	1/95	Ba	0.0589		mg/L	ICAP
MW-04	1/95	B	0.046	U	mg/L	ICAP
MW-04	1/95	Ti	0.042	U	mg/L	ICAP
MOC-08	1/95	Na-1	17.5		mg/L	ICAP
MOC-08	1/95	K	1.4	U	mg/L	ICAP
MOC-08	1/95	Ca	27.9		mg/L	ICAP
MOC-08	1/95	Mg	6.75		mg/L	ICAP
MOC-08	1/95	Fe	11.1		mg/L	ICAP
MOC-08	1/95	Mn	0.0639		mg/L	ICAP
MOC-08	1/95	Co	0.0065	U	mg/L	ICAP
MOC-08	1/95	Mo	0.0060	U	mg/L	ICAP
MOC-08	1/95	Al	0.12		mg/L	ICAP
MOC-08	1/95	As	0.031	U	mg/L	ICAP
MOC-08	1/95	Se	0.032	U	mg/L	ICAP
MOC-08	1/95	Cd	0.0021	U	mg/L	ICAP
MOC-08	1/95	Be	0.0007	U	mg/L	ICAP
MOC-08	1/95	Cu	0.049	U	mg/L	ICAP
MOC-08	1/95	Cr	0.0018	U	mg/L	ICAP
MOC-08	1/95	Ni	0.0071	U	mg/L	ICAP
MOC-08	1/95	Zn	0.0169		mg/L	ICAP
MOC-08	1/95	Ag	0.015	U	mg/L	ICAP
MOC-08	1/95	Tl	0.0094	U	mg/L	ICAP
MOC-08	1/95	Pb	0.033	U	mg/L	ICAP
MOC-08	1/95	Li	0.24	U	mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOC-08	1/95	Sr	0.191		mg/L	ICAP
MOC-08	1/95	V	0.033	U	mg/L	ICAP
MOC-08	1/95	Ba	0.109		mg/L	ICAP
MOC-08	1/95	B	0.094		mg/L	ICAP
MOC-08	1/95	Ti	0.042	U	mg/L	ICAP
MW-02	1/95	Na-1	20.3		mg/L	ICAP
MW-02	1/95	K	1.4	U	mg/L	ICAP
MW-02	1/95	Ca	66.9		mg/L	ICAP
MW-02	1/95	Mg	4.26		mg/L	ICAP
MW-02	1/95	Fe	5.04		mg/L	ICAP
MW-02	1/95	Mn	0.0995		mg/L	ICAP
MW-02	1/95	Co	0.0065	U	mg/L	ICAP
MW-02	1/95	Mo	0.0060	U	mg/L	ICAP
MW-02	1/95	Al	0.11	U	mg/L	ICAP
MW-02	1/95	As	0.031	U	mg/L	ICAP
MW-02	1/95	Se	0.032	U	mg/L	ICAP
MW-02	1/95	Cd	0.0021	U	mg/L	ICAP
MW-02	1/95	Be	0.0009	U	mg/L	ICAP
MW-02	1/95	Cu	0.049	U	mg/L	ICAP
MW-02	1/95	Cr	0.0022		mg/L	ICAP
MW-02	1/95	Ni	0.0078		mg/L	ICAP
MW-02	1/95	Zn	0.0063		mg/L	ICAP
MW-02	1/95	Ag	0.017		mg/L	ICAP
MW-02	1/95	Tl	0.0099	U	mg/L	ICAP
MW-02	1/95	Pb	0.033	U	mg/L	ICAP
MW-02	1/95	Li	0.24	U	mg/L	ICAP
MW-02	1/95	Sr	0.369		mg/L	ICAP
MW-02	1/95	V	0.033	U	mg/L	ICAP
MW-02	1/95	Ba	0.0844		mg/L	ICAP
MW-02	1/95	B	0.046	U	mg/L	ICAP
MW-02	1/95	Ti	0.042	U	mg/L	ICAP
MOC-07	1/95	Na-1	19.7		mg/L	ICAP
MOC-07	1/95	K	1.4	U	mg/L	ICAP
MOC-07	1/95	Ca	21.0		mg/L	ICAP
MOC-07	1/95	Mg	4.37		mg/L	ICAP
MOC-07	1/95	Fe	4.24		mg/L	ICAP
MOC-07	1/95	Mn	0.0531		mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOC-07	1/95	Co	0.0065	U	mg/L	ICAP
MOC-07	1/95	Mo	0.0060	U	mg/L	ICAP
MOC-07	1/95	Al	0.11	U	mg/L	ICAP
MOC-07	1/95	As	0.031	U	mg/L	ICAP
MOC-07	1/95	Se	0.032	U	mg/L	ICAP
MOC-07	1/95	Cd	0.0021	U	mg/L	ICAP
MOC-07	1/95	Be	0.0007	U	mg/L	ICAP
MOC-07	1/95	Cu	0.049	U	mg/L	ICAP
MOC-07	1/95	Cr	0.0018	U	mg/L	ICAP
MOC-07	1/95	Ni	0.0071	U	mg/L	ICAP
MOC-07	1/95	Zn	0.0494		mg/L	ICAP
MOC-07	1/95	Ag	0.015	U	mg/L	ICAP
MOC-07	1/95	Tl	0.0099	U	mg/L	ICAP
MOC-07	1/95	Pb	0.033	U	mg/L	ICAP
MOC-07	1/95	Li	0.24	U	mg/L	ICAP
MOC-07	1/95	Sr	0.153		mg/L	ICAP
MOC-07	1/95	V	0.033	U	mg/L	ICAP
MOC-07	1/95	Ba	0.0846		mg/L	ICAP
MOC-07	1/95	B	0.046	U	mg/L	ICAP
MOC-07	1/95	Ti	0.42	U	mg/L	ICAP
MOC-03	1/95	Na-1	18.8		mg/L	ICAP
MOC-03	1/95	K	1.4	U	mg/L	ICAP
MOC-03	1/95	Ca	31.8		mg/L	ICAP
MOC-03	1/95	Mg	2.52		mg/L	ICAP
MOC-03	1/95	Fe	2.11		mg/L	ICAP
MOC-03	1/95	Mn	0.0565		mg/L	ICAP
MOC-03	1/95	Co	0.0065	U	mg/L	ICAP
MOC-03	1/95	Mo	0.0060	U	mg/L	ICAP
MOC-03	1/95	Al	0.11	U	mg/L	ICAP
MOC-03	1/95	As	0.031	U	mg/L	ICAP
MOC-03	1/95	Se	0.032	U	mg/L	ICAP
MOC-03	1/95	Cd	0.0021	U	mg/L	ICAP
MOC-03	1/95	Be	0.0007	U	mg/L	ICAP
MOC-03	1/95	Cu	0.049	U	mg/L	ICAP
MOC-03	1/95	Cr	0.0018	U	mg/L	ICAP
MOC-03	1/95	Ni	0.0071	U	mg/L	ICAP
MOC-03	1/95	Zn	0.0601		mg/L	ICAP
MOC-03	1/95	Ag	0.015	U	mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOC-03	1/95	Tl	0.0099	U	mg/L	ICAP
MOC-03	1/95	Pb	0.033	U	mg/L	ICAP
MOC-03	1/95	Li	0.24	U	mg/L	ICAP
MOC-03	1/95	Sr	0.191		mg/L	ICAP
MOC-03	1/95	V	0.033	U	mg/L	ICAP
MOC-03	1/95	Ba	0.0534		mg/L	ICAP
MOC-03	1/95	B	0.046	U	mg/L	ICAP
MOC-03	1/95	Ti	0.042	U	mg/L	ICAP
MOC-11	1/95	Na-1	19.1		mg/L	ICAP
MOC-11	1/95	K	1.4	U	mg/L	ICAP
MOC-11	1/95	Ca	30.3		mg/L	ICAP
MOC-11	1/95	Mg	3.05		mg/L	ICAP
MOC-11	1/95	Fe	2.44		mg/L	ICAP
MOC-11	1/95	Mn	0.0512		mg/L	ICAP
MOC-11	1/95	Co	0.0026		mg/L	ICAP
MOC-11	1/95	Mo	0.0035		mg/L	ICAP
MOC-11	1/95	Al	0.12	U	mg/L	ICAP
MOC-11	1/95	As	0.030	U	mg/L	ICAP
MOC-11	1/95	Se	0.022	U	mg/L	ICAP
MOC-11	1/95	Cd	0.0020	U	mg/L	ICAP
MOC-11	1/95	Be	0.0004	U	mg/L	ICAP
MOC-11	1/95	Cu	0.016	U	mg/L	ICAP
MOC-11	1/95	Cr	0.0027	U	mg/L	ICAP
MOC-11	1/95	Ni	0.0030		mg/L	ICAP
MOC-11	1/95	Zn	0.0026	U	mg/L	ICAP
MOC-11	1/95	Ag	0.018	U	mg/L	ICAP
MOC-11	1/95	Tl	0.012	U	mg/L	ICAP
MOC-11	1/95	Pb	0.024	U	mg/L	ICAP
MOC-11	1/95	Li	0.27	U	mg/L	ICAP
MOC-11	1/95	Sr	0.205		mg/L	ICAP
MOC-11	1/95	V	0.033	U	mg/L	ICAP
MOC-11	1/95	Ba	0.0788		mg/L	ICAP
MOC-11	1/95	B	0.083		mg/L	ICAP
MOC-11	1/95	Ti	0.0084	U	mg/L	ICAP
MOC-04	1/95	Na-1	20.6		mg/L	ICAP
MOC-04	1/95	K	1.9		mg/L	ICAP
MOC-04	1/95	Ca	29.2		mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOC-04	1/95	Mg	2.39		mg/L	ICAP
MOC-04	1/95	Fe	3.29		mg/L	ICAP
MOC-04	1/95	Mn	0.0591		mg/L	ICAP
MOC-04	1/95	Co	0.0033		mg/L	ICAP
MOC-04	1/95	Mo	0.0027	U	mg/L	ICAP
MOC-04	1/95	Al	0.12	U	mg/L	ICAP
MOC-04	1/95	As	0.030	U	mg/L	ICAP
MOC-04	1/95	Se	0.022	U	mg/L	ICAP
MOC-04	1/95	Cd	0.0020	U	mg/L	ICAP
MOC-04	1/95	Be	0.0004	U	mg/L	ICAP
MOC-04	1/95	Cu	0.060		mg/L	ICAP
MOC-04	1/95	Cr	0.0027	U	mg/L	ICAP
MOC-04	1/95	Ni	0.0019	U	mg/L	ICAP
MOC-04	1/95	Zn	0.0427		mg/L	ICAP
MOC-04	1/95	Ag	0.018	U	mg/L	ICAP
MOC-04	1/95	Tl	0.016		mg/L	ICAP
MOC-04	1/95	Pb	0.024	U	mg/L	ICAP
MOC-04	1/95	Li	0.31		mg/L	ICAP
MOC-04	1/95	Sr	0.185		mg/L	ICAP
MOC-04	1/95	V	0.033		mg/L	ICAP
MOC-04	1/95	Ba	0.068		mg/L	ICAP
MOC-04	1/95	B	0.071	U	mg/L	ICAP
MOC-04	1/95	Ti	0.0084	U	mg/L	ICAP
MW-01	1/95	Na-1	18.0		mg/L	ICAP
MW-01	1/95	K	1.7		mg/L	ICAP
MW-01	1/95	Ca	22.4		mg/L	ICAP
MW-01	1/95	Mg	2.75		mg/L	ICAP
MW-01	1/95	Fe	2.71		mg/L	ICAP
MW-01	1/95	Mn	0.0521		mg/L	ICAP
MW-01	1/95	Co	0.0032		mg/L	ICAP
MW-01	1/95	Mo	0.0027	U	mg/L	ICAP
MW-01	1/95	Al	0.12	U	mg/L	ICAP
MW-01	1/95	As	0.030	U	mg/L	ICAP
MW-01	1/95	Se	0.022	U	mg/L	ICAP
MW-01	1/95	Cd	0.0020	U	mg/L	ICAP
MW-01	1/95	Be	0.0004	U	mg/L	ICAP
MW-01	1/95	Cu	0.016	U	mg/L	ICAP
MW-01	1/95	Cr	0.0027	U	mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MW-01	1/95	Ni	0.0019	U	mg/L	ICAP
MW-01	1/95	Zn	0.0152		mg/L	ICAP
MW-01	1/95	Ag	0.018	U	mg/L	ICAP
MW-01	1/95	Tl	0.012	U	mg/L	ICAP
MW-01	1/95	Pb	0.024	U	mg/L	ICAP
MW-01	1/95	Li	0.27	U	mg/L	ICAP
MW-01	1/95	Sr	0.161		mg/L	ICAP
MW-01	1/95	V	0.033	U	mg/L	ICAP
MW-01	1/95	Ba	0.0508		mg/L	ICAP
MW-01	1/95	B	0.071	U	mg/L	ICAP
MW-01	1/95	Ti	0.0084	U	mg/L	ICAP
MW-112	1/95	Na-1	16.5		mg/L	ICAP
MW-112	1/95	K	1.4	U	mg/L	ICAP
MW-112	1/95	Ca	13.8		mg/L	ICAP
MW-112	1/95	Mg	4.97		mg/L	ICAP
MW-112	1/95	Fe	5.79		mg/L	ICAP
MW-112	1/95	Mn	0.0299		mg/L	ICAP
MW-112	1/95	Co	0.0054		mg/L	ICAP
MW-112	1/95	Mo	0.0027	U	mg/L	ICAP
MW-112	1/95	Al	0.12	U	mg/L	ICAP
MW-112	1/95	As	0.030	U	mg/L	ICAP
MW-112	1/95	Se	0.022	U	mg/L	ICAP
MW-112	1/95	Cd	0.0020	U	mg/L	ICAP
MW-112	1/95	Be	0.0004	U	mg/L	ICAP
MW-112	1/95	Cu	0.016	U	mg/L	ICAP
MW-112	1/95	Cr	0.0027	U	mg/L	ICAP
MW-112	1/95	Ni	0.0019	U	mg/L	ICAP
MW-112	1/95	Zn	0.0026	U	mg/L	ICAP
MW-112	1/95	Ag	0.018	U	mg/L	ICAP
MW-112	1/95	Tl	0.012	U	mg/L	ICAP
MW-112	1/95	Pb	0.024	U	mg/L	ICAP
MW-112	1/95	Li	0.27	U	mg/L	ICAP
MW-112	1/95	Sr	0.108		mg/L	ICAP
MW-112	1/95	V	0.033	U	mg/L	ICAP
MW-112	1/95	Ba	0.0560		mg/L	ICAP
MW-112	1/95	B	0.073		mg/L	ICAP
MW-112	1/95	Ti	0.0084	U	mg/L	ICAP

TABLE B.12
GROUNDWATER DATA FOR METALS
JANUARY 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result		Units	Analytical Method
MOC-02	1/95	Na-1	21.7		mg/L	ICAP
MOC-02	1/95	K	1.4	U	mg/L	ICAP
MOC-02	1/95	Ca	39.1		mg/L	ICAP
MOC-02	1/95	Mg	3.71		mg/L	ICAP
MOC-02	1/95	Fe	3.46		mg/L	ICAP
MOC-02	1/95	Mn	0.0662		mg/L	ICAP
MOC-02	1/95	Co	0.0013	U	mg/L	ICAP
MOC-02	1/95	Mo	0.0027	U	mg/L	ICAP
MOC-02	1/95	Al	0.12	U	mg/L	ICAP
MOC-02	1/95	As	0.030	U	mg/L	ICAP
MOC-02	1/95	Se	0.022	U	mg/L	ICAP
MOC-02	1/95	Cd	0.0020	U	mg/L	ICAP
MOC-02	1/95	Be	0.0005	U	mg/L	ICAP
MOC-02	1/95	Cu	0.016	U	mg/L	ICAP
MOC-02	1/95	Cr	0.0027	U	mg/L	ICAP
MOC-02	1/95	Ni	0.0019	U	mg/L	ICAP
MOC-02	1/95	Zn	0.0074		mg/L	ICAP
MOC-02	1/95	Ag	0.018	U	mg/L	ICAP
MOC-02	1/95	Tl	0.012	U	mg/L	ICAP
MOC-02	1/95	Pb	0.024	U	mg/L	ICAP
MOC-02	1/95	Li	0.27	U	mg/L	ICAP
MOC-02	1/95	Sr	0.253		mg/L	ICAP
MOC-02	1/95	V	0.033	U	mg/L	ICAP
MOC-02	1/95	Ba	0.0745		mg/L	ICAP
MOC-02	1/95	B	0.071	U	mg/L	ICAP
MOC-02	1/95	Ti	0.0084	U	mg/L	ICAP

TABLE B.13
GROUNDWATER DATA FOR OTHER ANALYSES
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
AS-01	29-Aug-95	Chloride	24.3	mg/l	E300.0
AS-02	31-Aug-95	Chloride	33	mg/l	E300.0
MOC-02	28-Aug-95	Alkalinity, Total (as CaCO3)	80.2	mg/l	E310.1
MOC-02	28-Aug-95	Chloride	35	mg/l	E300.0
MOC-03	1-Sep-95	Chloride	25.3	mg/l	E300.0
MOC-04	1-Sep-95	Chloride	25.4	mg/l	E300.0
MOC-05	29-Aug-95	Chloride	29.1	mg/l	E300.0
MOC-07	29-Aug-95	Chloride	28	mg/l	E300.0
MOC-08	28-Aug-95	Alkalinity, Total (as CaCO3)	57.6	mg/l	E310.1
MOC-08	28-Aug-95	Chloride	16.5	mg/l	E300.0
MOC-10	29-Aug-95	Alkalinity, Total (as CaCO3)	74.6	mg/l	E310.1
MOC-10	29-Aug-95	Chloride	21.2	mg/l	E300.0
MOC-11	31-Aug-95	Chloride	27.7	mg/l	E300.0
MOC-12	29-Aug-95	Chloride	64.8	mg/l	E300.0
MOC-13	30-Aug-95	Chloride	25.3	mg/l	E300.0
MOC-19	30-Aug-95	Alkalinity, Total (as CaCO3)	52.9	mg/l	E310.1
MOC-19	30-Aug-95	Chloride	21.6	mg/l	E300.0
MOC-20	30-Aug-95	Chloride	34.1	mg/l	E300.0
MOC-21	29-Aug-95	Alkalinity, Total (as CaCO3)	92.9	mg/l	E310.1
MOC-21	29-Aug-95	Chloride	25.9	mg/l	E300.0
MW-01	1-Sep-95	Chloride	21.5	mg/l	E300.0
MW-02	28-Aug-95	Alkalinity, Total (as CaCO3)	84.8	mg/l	E310.1
MW-02	28-Aug-95	Chloride	29.1	mg/l	E300.0
MW-03	30-Aug-95	Chloride	12.5	mg/l	E300.0
MW-04	30-Aug-95	Chloride	20.6	mg/l	E300.0
MW-05	31-Aug-95	Chloride	24.7	mg/l	E300.0
MW-06	29-Aug-95	Chloride	17.8	mg/l	E300.0
MW-07	28-Aug-95	Alkalinity, Total (as CaCO3)	49.3	mg/l	E310.1
MW-07	28-Aug-95	Chloride	40	mg/l	E300.0
MW-08	1-Sep-95	Chloride	33.8	mg/l	E300.0
MW-09	28-Aug-95	Chloride	49.1	mg/l	E300.0
MW-10	28-Aug-95	Chloride	31.7	mg/l	E300.0
MW-11	30-Aug-95	Chloride	17.7	mg/l	E300.0
MW-111	1-Sep-95	Alkalinity, Total (as CaCO3)	17.5	mg/l	E310.1
MW-111	1-Sep-95	Chloride	21.4	mg/l	E300.0
MW-112	29-Aug-95	Alkalinity, Total (as CaCO3)	79.5	mg/l	E310.1
MW-112	29-Aug-95	Chloride	15.1	mg/l	E300.0
MW-113	31-Aug-95	Chloride	36.6	mg/l	E300.0
MW-12	31-Aug-95	Chloride	32.5	mg/l	E300.0
MW-13	31-Aug-95	Chloride	6.8	mg/l	E300.0
MW-14	30-Aug-95	Alkalinity, Total (as CaCO3)	102	mg/l	E310.1

TABLE B.13
GROUNDWATER DATA FOR OTHER ANALYSES
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
MW-14	30-Aug-95	Chloride	21.8	mg/l	E300.0
MW-15	31-Aug-95	Alkalinity, Total (as CaCO3)	132	mg/l	E310.1
MW-15	31-Aug-95	Chloride	18.1	mg/l	E300.0
MW-16	31-Aug-95	Alkalinity, Total (as CaCO3)	173	mg/l	E310.1
MW-16	31-Aug-95	Chloride	41	mg/l	E300.0
MW-17	30-Aug-95	Chloride	17.9	mg/l	E300.0
MW-18	31-Aug-95	Alkalinity, Total (as CaCO3)	194	mg/l	E310.1
MW-18	31-Aug-95	Chloride	34.9	mg/l	E300.0
MW-19	30-Aug-95	Chloride	22.6	mg/l	E300.0

TABLE B.14
SURFACE WATER DATA
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH, SOUTH CAROLINA

Sample Location	Sample Date	Analyte	Result	Units	Analytical Method
SW-01	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
SW-01	1-Sep-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
SW-01	1-Sep-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
SW-01	1-Sep-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
SW-01	1-Sep-95	Benzene	0.4 U	ug/l	E602
SW-01	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
SW-01	1-Sep-95	Ethylbenzene	0.4 U	ug/l	E602
SW-01	1-Sep-95	Toluene	0.4 U	ug/l	E602
SW-01	1-Sep-95	Xylene (total)	0.4 U	ug/l	E602
SW-01	1-Sep-95	Total Organic Carbon	6.4	mg/l	E415.1
SW-02	1-Sep-95	1,2,3,4-Tetramethylbenzene	10 U	ug/l	E602
SW-02	1-Sep-95	1,2,3-Trimethylbenzene	4 U	ug/l	E602
SW-02	1-Sep-95	1,2,4-Trimethylbenzene	5.6	ug/l	E602
SW-02	1-Sep-95	1,3,5-Trimethylbenzene	4 U	ug/l	E602
SW-02	1-Sep-95	Benzene	83	ug/l	E602
SW-02	1-Sep-95	Chlorobenzene	4 U	ug/l	E602
SW-02	1-Sep-95	Ethylbenzene	20	ug/l	E602
SW-02	1-Sep-95	Toluene	170	ug/l	E602
SW-02	1-Sep-95	Xylene (total)	85	ug/l	E602
SW-02	1-Sep-95	Total Organic Carbon	6.9	mg/l	E415.1
SW-03	1-Sep-95	1,2,3,4-Tetramethylbenzene	10 U	ug/l	E602
SW-03	1-Sep-95	1,2,3-Trimethylbenzene	11	ug/l	E602
SW-03	1-Sep-95	1,2,4-Trimethylbenzene	38	ug/l	E602
SW-03	1-Sep-95	1,3,5-Trimethylbenzene	4 U	ug/l	E602
SW-03	1-Sep-95	Benzene	580	ug/l	E602
SW-03	1-Sep-95	Chlorobenzene	4 U	ug/l	E602
SW-03	1-Sep-95	Ethylbenzene	12	ug/l	E602
SW-03	1-Sep-95	Toluene	230	ug/l	E602
SW-03	1-Sep-95	Xylene (total)	100	ug/l	E602
SW-03	1-Sep-95	Total Organic Carbon	10.8	mg/l	E415.1
SW-04	1-Sep-95	1,2,3,4-Tetramethylbenzene	1 U	ug/l	E602
SW-04	1-Sep-95	1,2,3-Trimethylbenzene	0.4 U	ug/l	E602
SW-04	1-Sep-95	1,2,4-Trimethylbenzene	0.4 U	ug/l	E602
SW-04	1-Sep-95	1,3,5-Trimethylbenzene	0.4 U	ug/l	E602
SW-04	1-Sep-95	Benzene	0.4 U	ug/l	E602
SW-04	1-Sep-95	Chlorobenzene	0.4 U	ug/l	E602
SW-04	1-Sep-95	Ethylbenzene	0.4 U	ug/l	E602
SW-04	1-Sep-95	Toluene	0.4 U	ug/l	E602
SW-04	1-Sep-95	Xylene (total)	0.4 U	ug/l	E602
SW-04	1-Sep-95	Total Organic Carbon	5.9	mg/l	E415.1

TABLE B.15
SEDIMENT DATA
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Sample Locations	Sample Date	Analyte	Result	Units	Analytical Method
SD-01	1-Sep-95	1,2,3,4-Tetramethylbenzene	1.1	ug/kg	SW8020
SD-01	1-Sep-95	1,2,3-Trimethylbenzene	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	1,2,4-Trimethylbenzene	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	1,3,5-Trimethylbenzene	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	Benzene	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	Chlorobenzene	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	Ethylbenzene	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	Toluene	1.1	ug/kg	SW8020
SD-01	1-Sep-95	Xylene (total)	0.5 U	ug/kg	SW8020
SD-01	1-Sep-95	Total Organic Carbon	0.3	%	CO2COUL
SD-02	1-Sep-95	1,2,3,4-Tetramethylbenzene	2300	ug/kg	SW8020
SD-02	1-Sep-95	1,2,3-Trimethylbenzene	3700	ug/kg	SW8020
SD-02	1-Sep-95	1,2,4-Trimethylbenzene	17000	ug/kg	SW8020
SD-02	1-Sep-95	1,3,5-Trimethylbenzene	2600	ug/kg	SW8020
SD-02	1-Sep-95	Benzene	2700	ug/kg	SW8020
SD-02	1-Sep-95	Chlorobenzene	280 U	ug/kg	SW8020
SD-02	1-Sep-95	Ethylbenzene	6600	ug/kg	SW8020
SD-02	1-Sep-95	Toluene	4600	ug/kg	SW8020
SD-02	1-Sep-95	Xylene (total)	21000	ug/kg	SW8020
SD-02	1-Sep-95	Total Organic Carbon	0.18	%	CO2COUL
SD-03	1-Sep-95	1,2,3,4-Tetramethylbenzene	2700	ug/kg	SW8020
SD-03	1-Sep-95	1,2,3-Trimethylbenzene	4000	ug/kg	SW8020
SD-03	1-Sep-95	1,2,4-Trimethylbenzene	29000	ug/kg	SW8020
SD-03	1-Sep-95	1,3,5-Trimethylbenzene	6500	ug/kg	SW8020
SD-03	1-Sep-95	Benzene	6300	ug/kg	SW8020
SD-03	1-Sep-95	Chlorobenzene	180	ug/kg	SW8020
SD-03	1-Sep-95	Ethylbenzene	2200	ug/kg	SW8020
SD-03	1-Sep-95	Toluene	2900	ug/kg	SW8020
SD-03	1-Sep-95	Xylene (total)	3200	ug/kg	SW8020
SD-03	1-Sep-95	Total Organic Carbon	1.6	%	CO2COUL
SD-04	1-Sep-95	1,2,3,4-Tetramethylbenzene	0.6 U	ug/kg	SW8020
SD-04	1-Sep-95	1,2,3-Trimethylbenzene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	1,2,4-Trimethylbenzene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	1,3,5-Trimethylbenzene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	Benzene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	Chlorobenzene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	Ethylbenzene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	Toluene	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	Xylene (total)	0.5 U	ug/kg	SW8020
SD-04	1-Sep-95	Total Organic Carbon	0.53	%	CO2COUL

TABLE B.16
DETECTED COMPOUNDS IN QC SAMPLES
AUGUST/SEPTEMBER 1995
RISK-BASED APPROACH TO REMEDIATION
MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

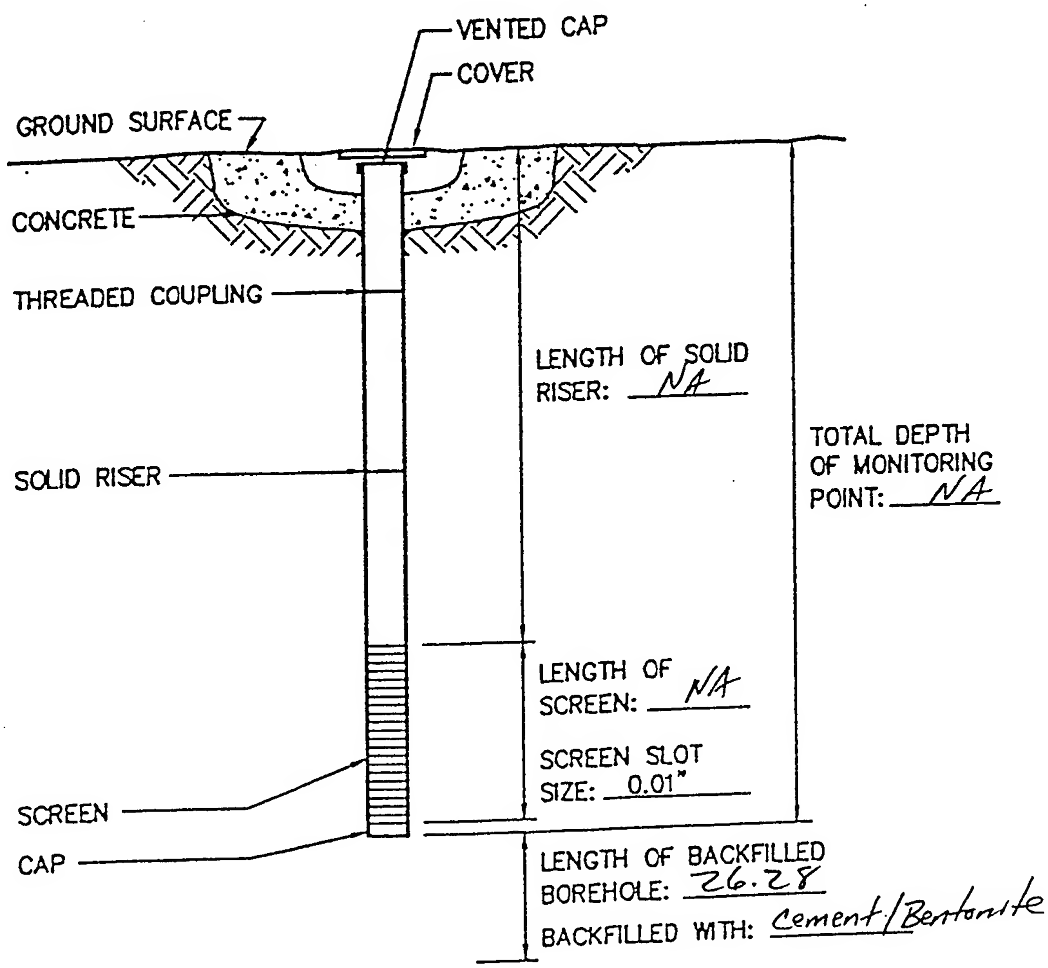
Field Blank	Blank Date	Analyte	Blank Concentration	Units	Sample Location	Sample Date	Sample Matrix
TB2	30-Aug-95	Toluene	1.1	ug/l	MOC-13	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MOC-19	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MOC-20	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MW-03	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MW-04	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MW-14	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MW-17	30-Aug-95	WG
TB2	30-Aug-95	Toluene	1.1	ug/l	MW-19	30-Aug-95	WG

APPENDIX C

BORING LOGS, WELL CONSTRUCTION DIAGRAMS, AND ORP/pe CONVERSION CALCULATIONS

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER CPT-01
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION NA GROUND SURFACE ELEVATION NA
DATUM FOR WATER LEVEL MEASUREMENT NA
SCREEN DIAMETER & MATERIAL NA SLOT SIZE NA
RISER DIAMETER & MATERIAL NA BOREHOLE DIAMETER 1½"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

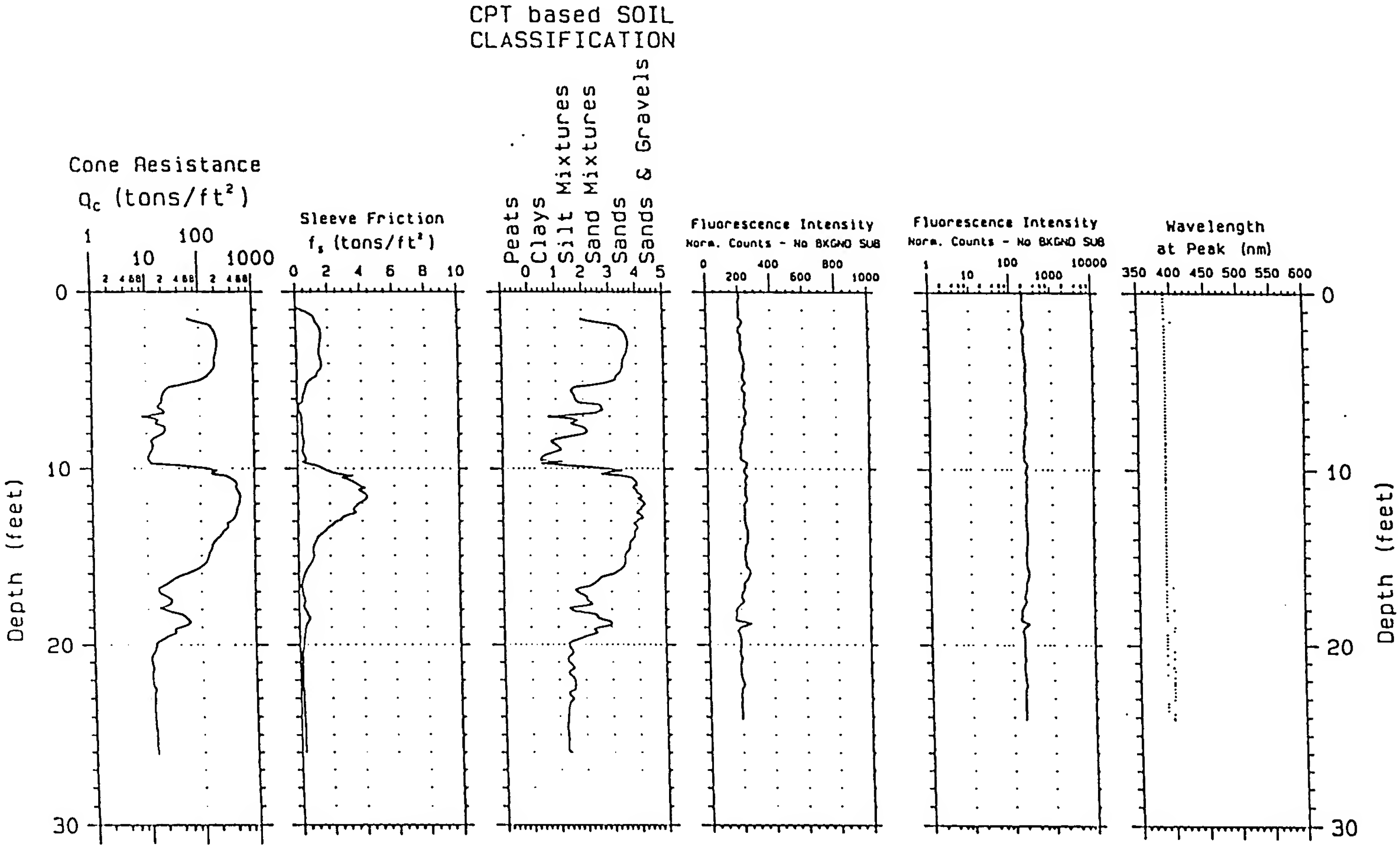
GROUND SURFACE 26.28 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

CPT-01
MOGAS Site
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 26.28

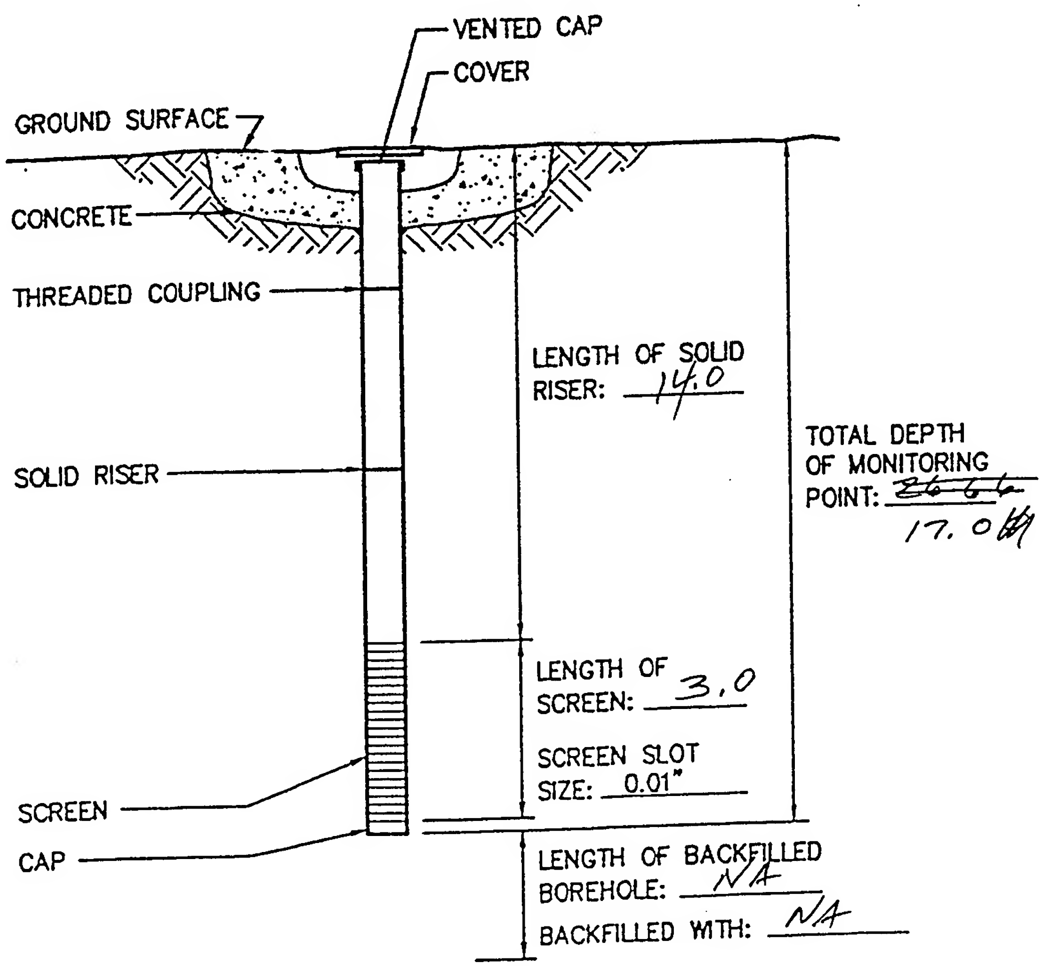
CPT-01

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER MOC-02
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION 25.23 ft msl GROUND SURFACE ELEVATION 25.50 ft msl
DATUM FOR WATER LEVEL MEASUREMENT 25.23 ft msl
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1½"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 17.0 FEET BELOW DATUM.

GROUND SURFACE 26.66 FEET

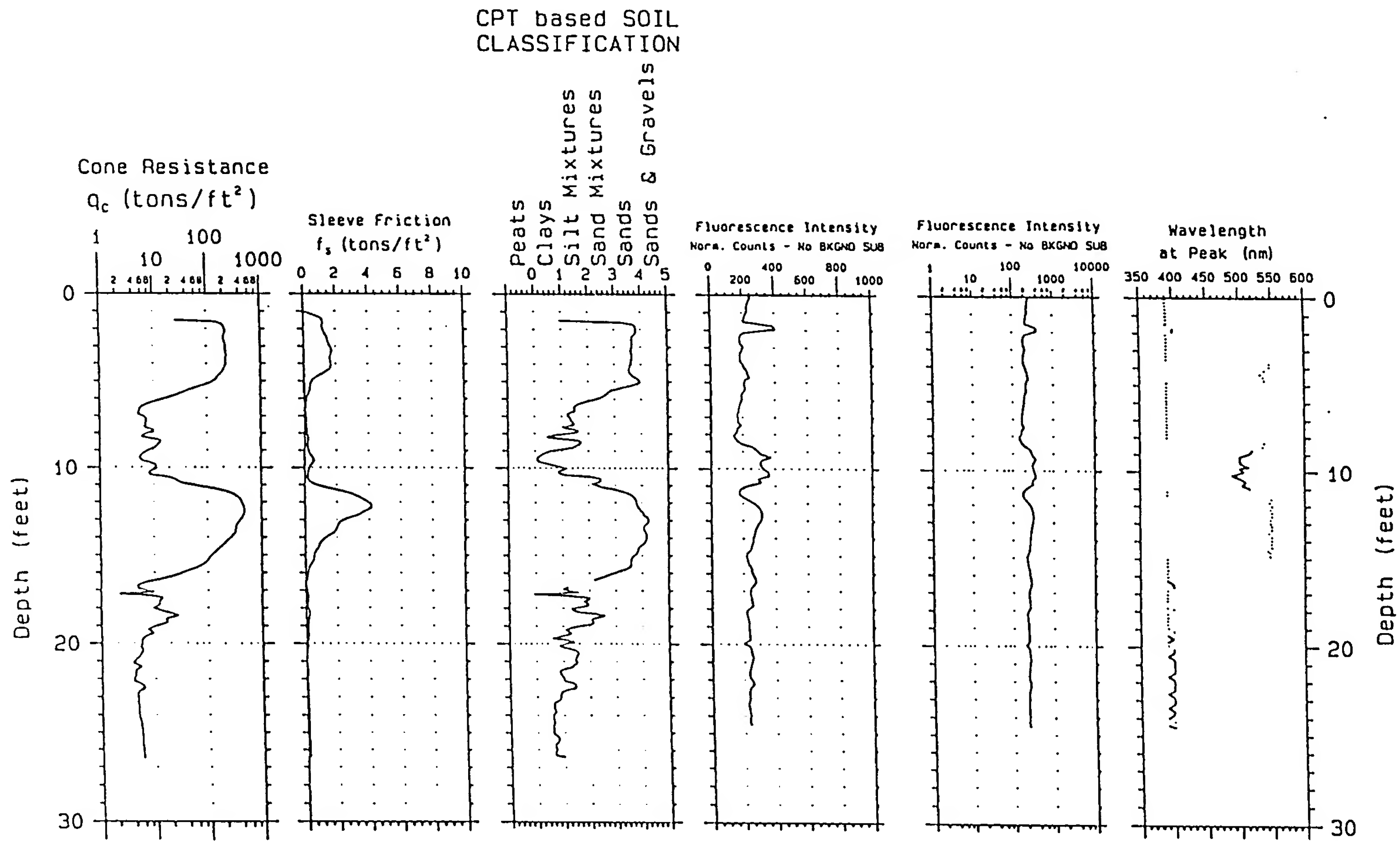
DRAFT

MONITORING POINT INSTALLATION RECORD

MOC-02

MOGAS Site
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 26.66

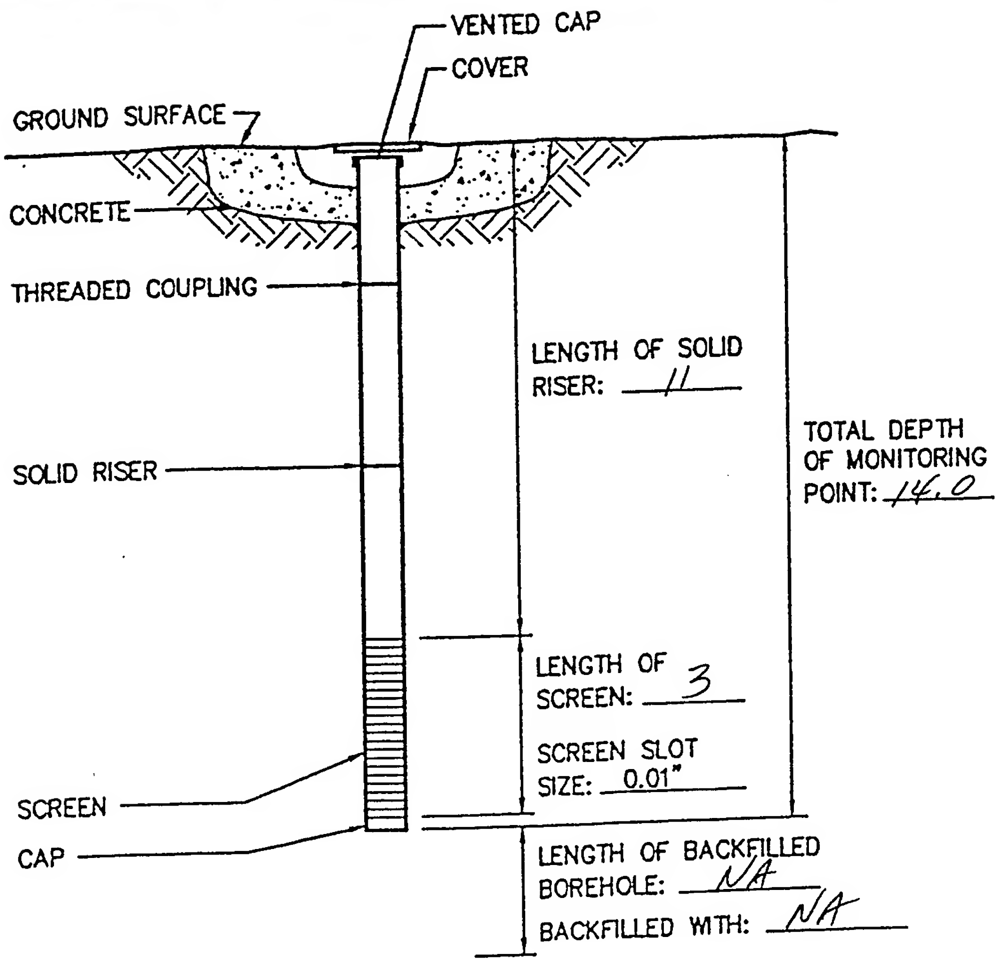
MOC-02

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER MOC-03
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION 24.56 ft msl GROUND SURFACE ELEVATION 24.81 ft msl
DATUM FOR WATER LEVEL MEASUREMENT 24.56 ft msl
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.
TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.
GROUND SURFACE 26.38 FEET

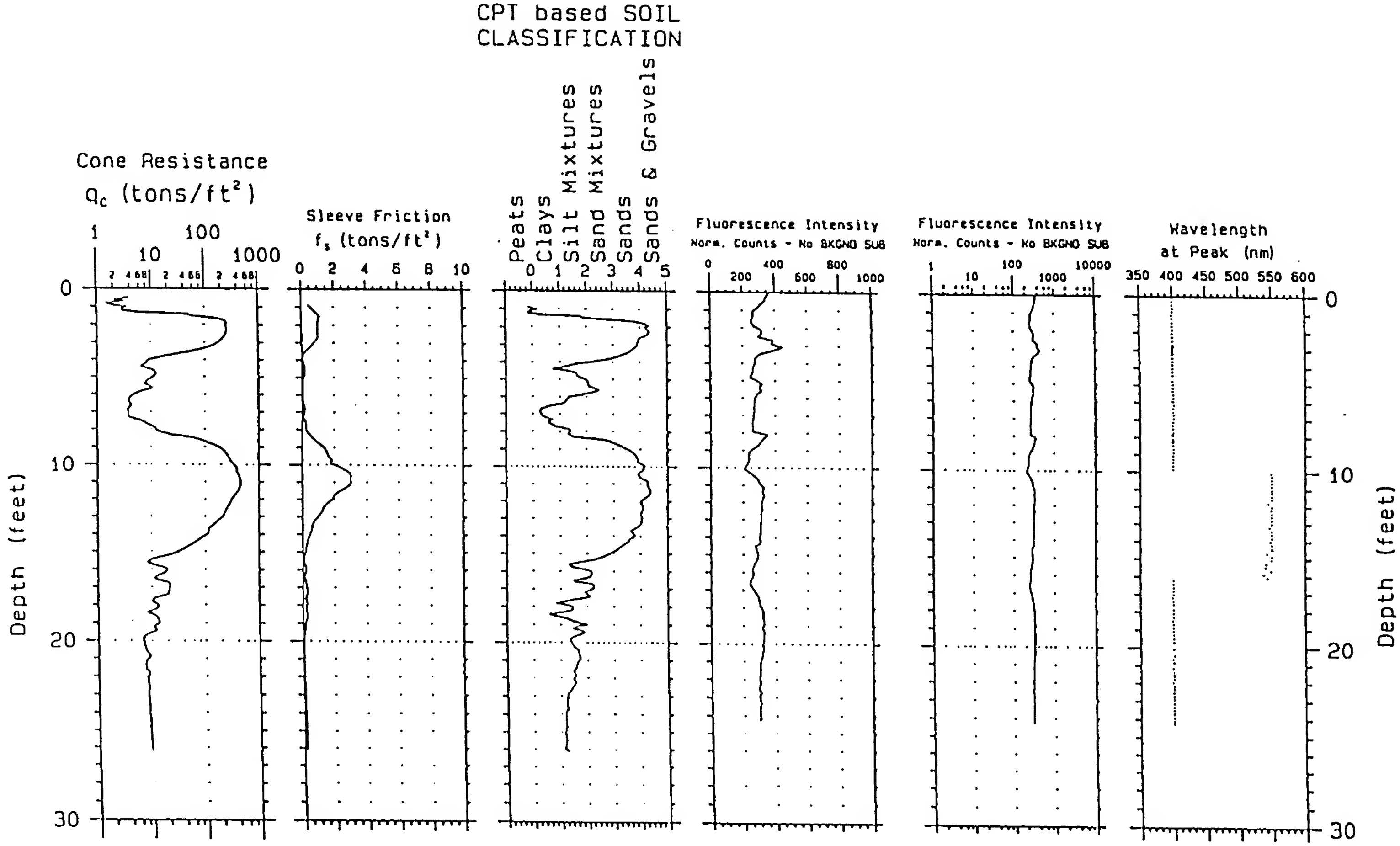
DRAFT

MONITORING POINT INSTALLATION RECORD

MOC-03

MOGAS Site
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 26.38

MOC-03

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER MOC-04

JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS

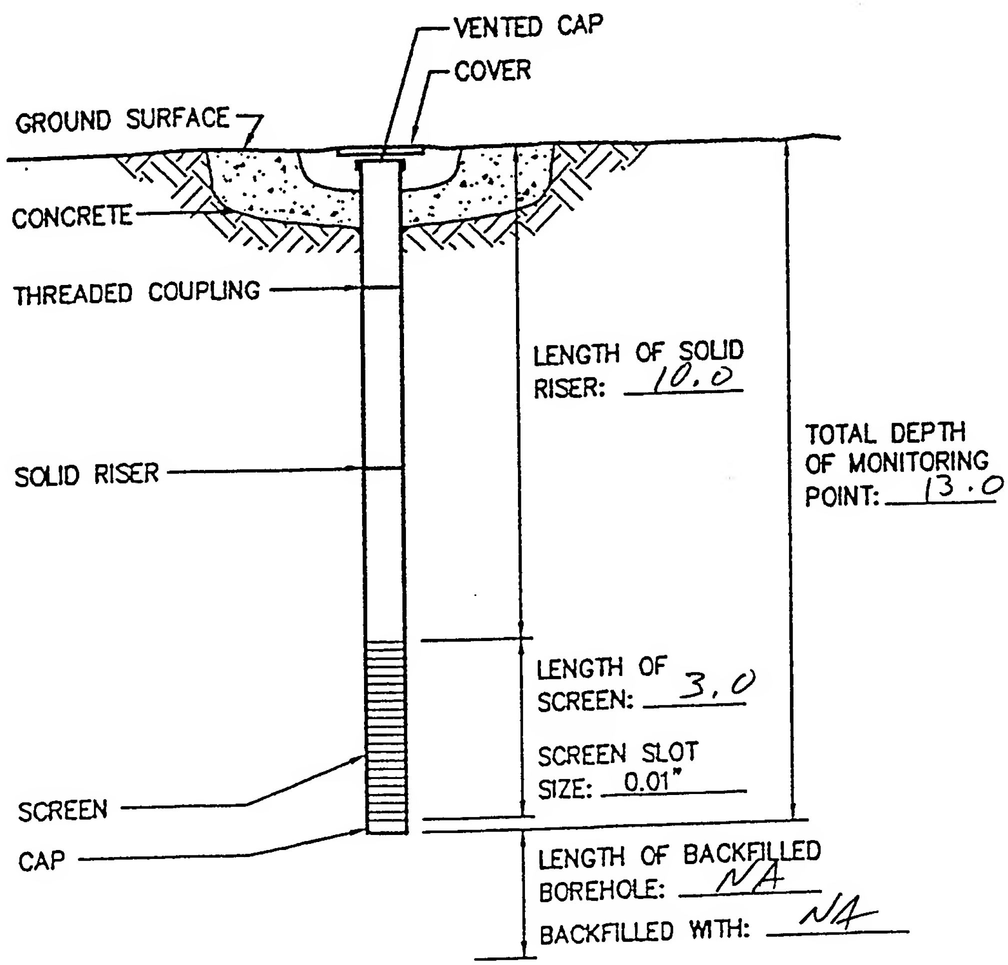
DATUM ELEVATION 24.46 ft msl GROUND SURFACE ELEVATION 24.70 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 24.46 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1½"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 13.0 FEET BELOW DATUM.

GROUND SURFACE 20.02 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

MOC-04

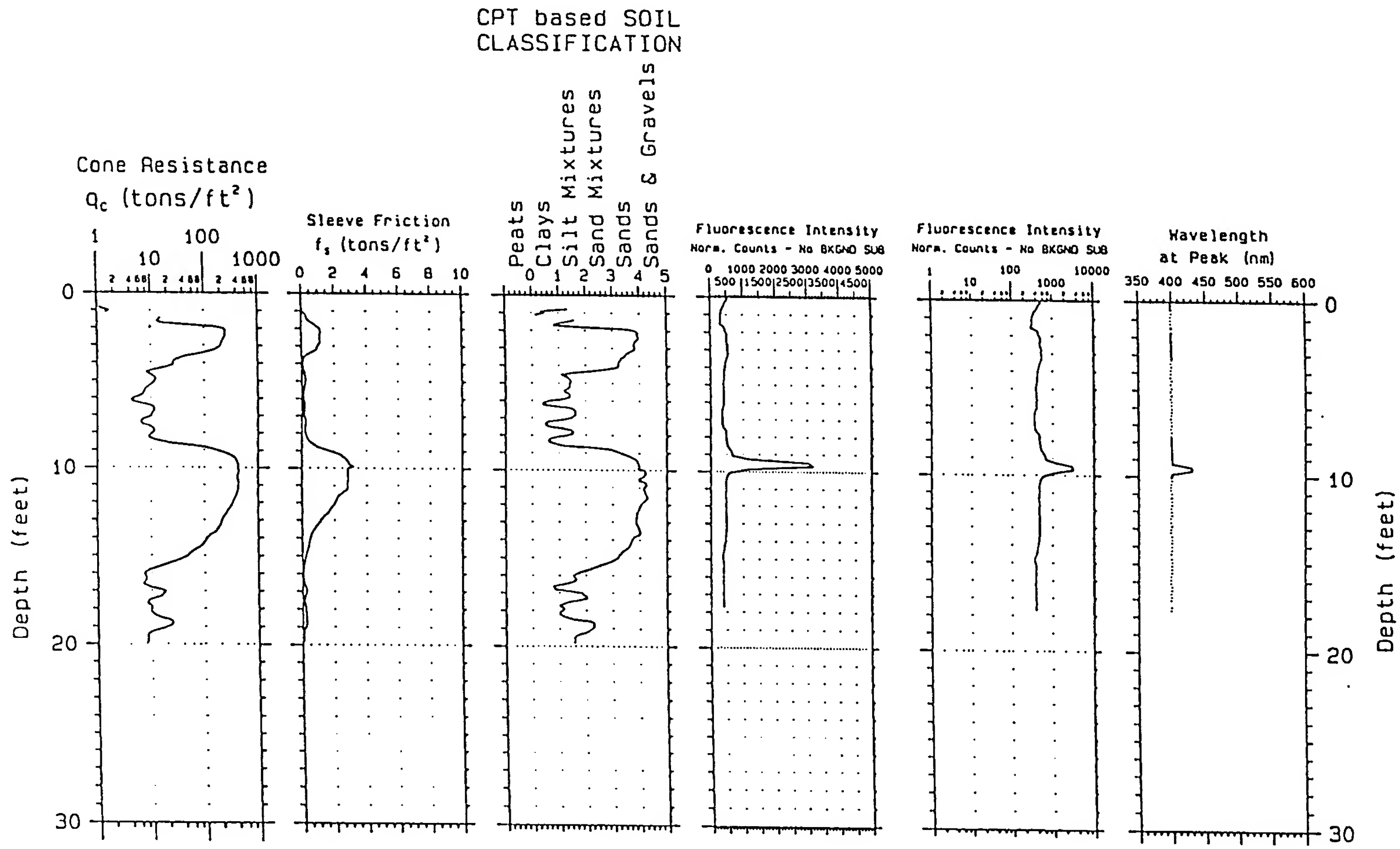
MOGAS Site

Myrtle Beach Air Force Base

South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 20.02

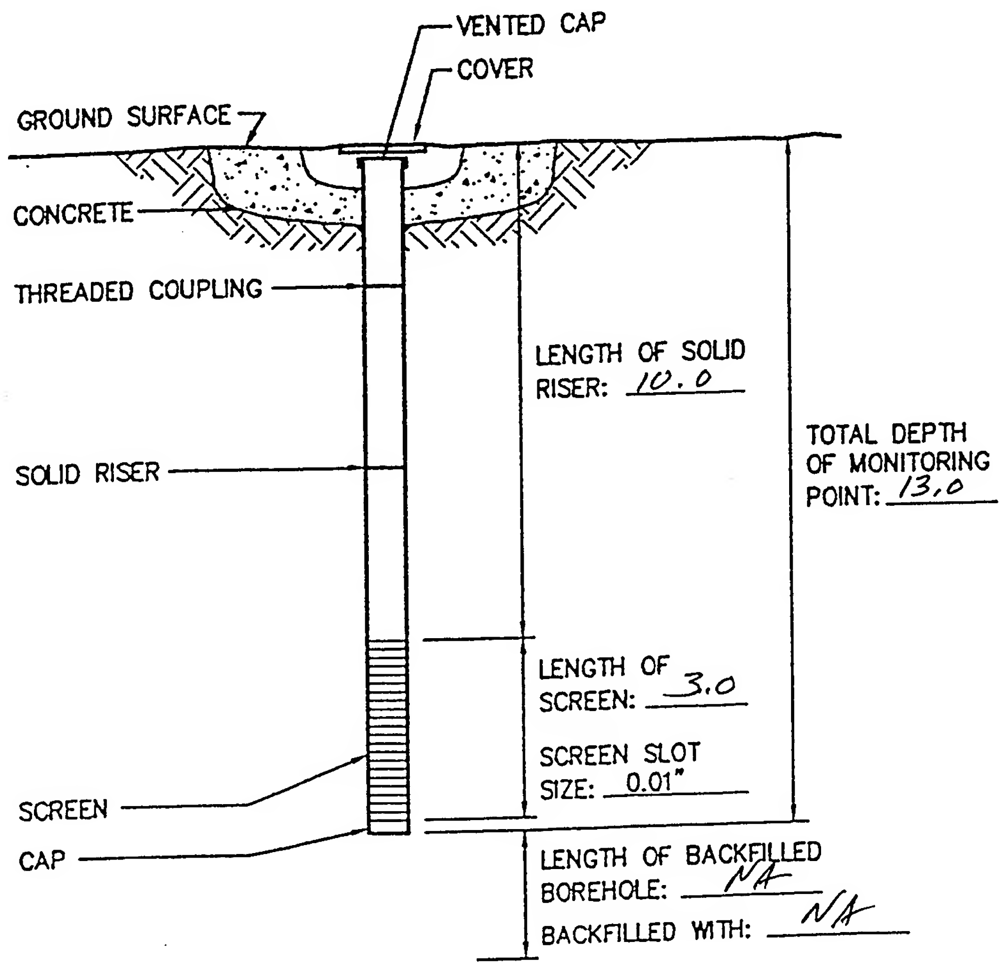
MOC-04

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER MOC-05
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION 24.57 GROUND SURFACE ELEVATION 24.63
DATUM FOR WATER LEVEL MEASUREMENT 24.57
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1½"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET
BELOW DATUM.

TOTAL MONITORING POINT DEPTH 13.0 FEET
BELOW DATUM.

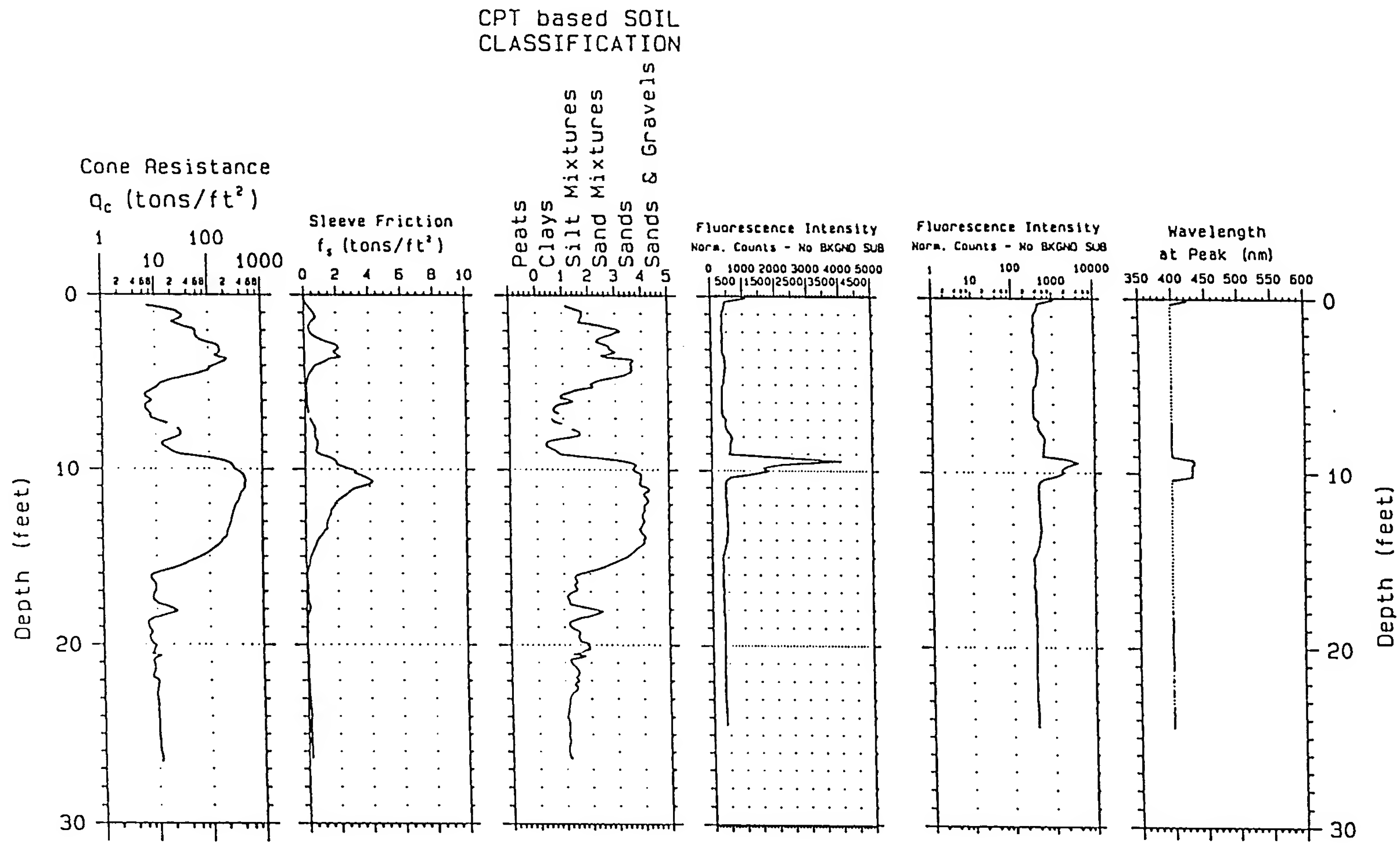
GROUND SURFACE 26.71 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

MOC-05
MOGAS Site
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 26.71

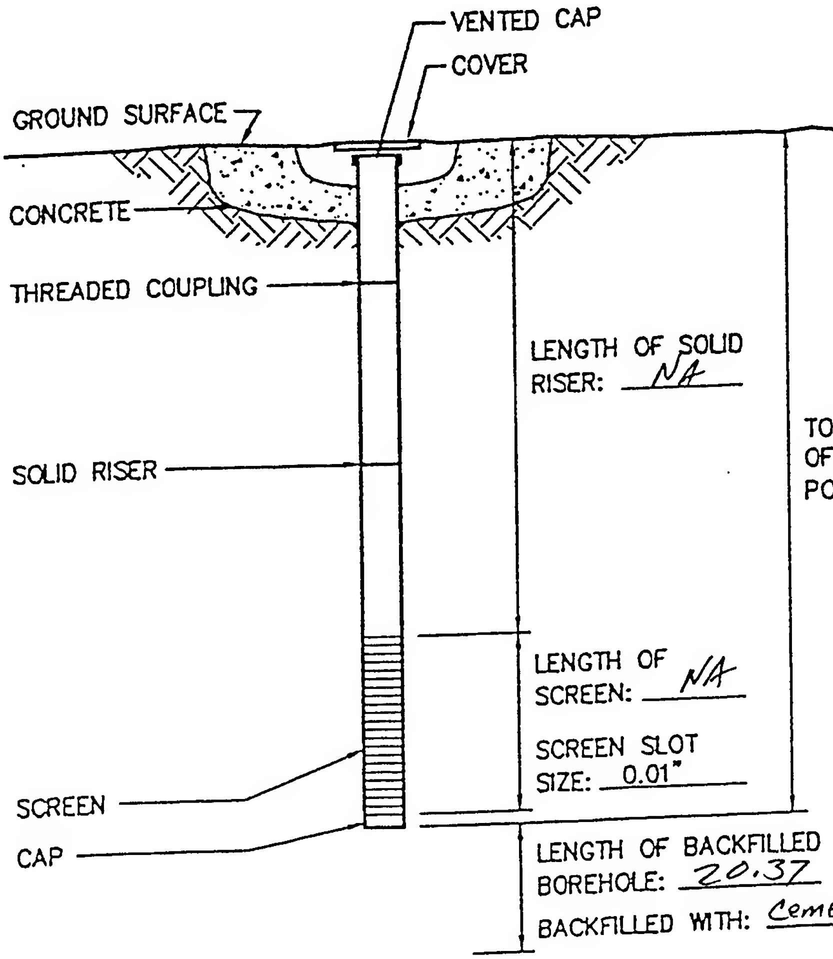
MOC-05

MOGAS SITE

Probing date; 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER CPT-06
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION NA GROUND SURFACE ELEVATION NA
DATUM FOR WATER LEVEL MEASUREMENT NA
SCREEN DIAMETER & MATERIAL NA SLOT SIZE NA
RISER DIAMETER & MATERIAL NA BOREHOLE DIAMETER 1½"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



LENGTH OF SOLID RISER: NA

TOTAL DEPTH OF MONITORING POINT: NA

LENGTH OF SCREEN: NA

SCREEN SLOT SIZE: 0.01"

LENGTH OF BACKFILLED BOREHOLE: 20.37

BACKFILLED WITH: Cement/Bentonite

(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

GROUND SURFACE 20.37 FEET

DRAFT

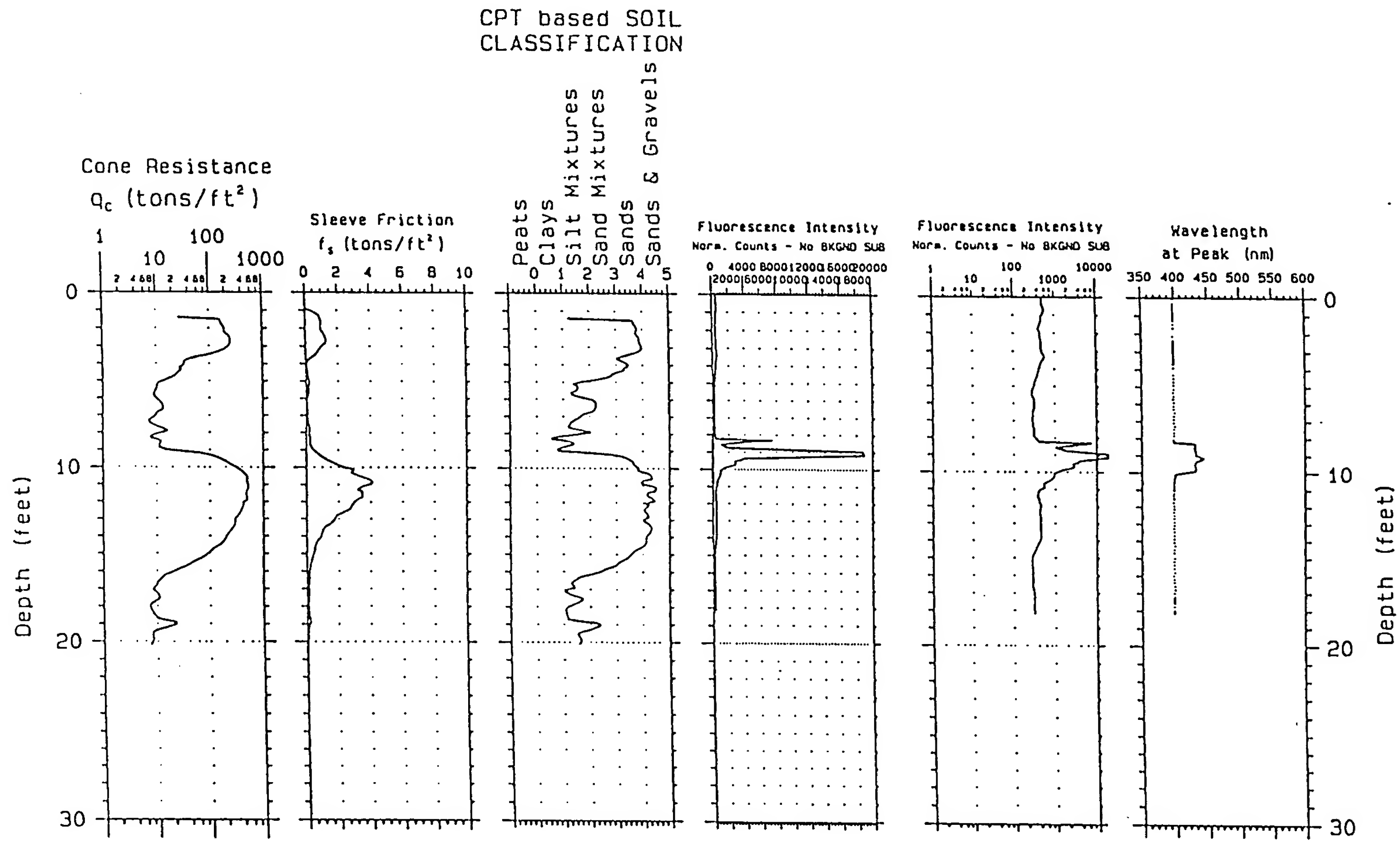
MONITORING POINT INSTALLATION RECORD

CPT-06

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 20.37

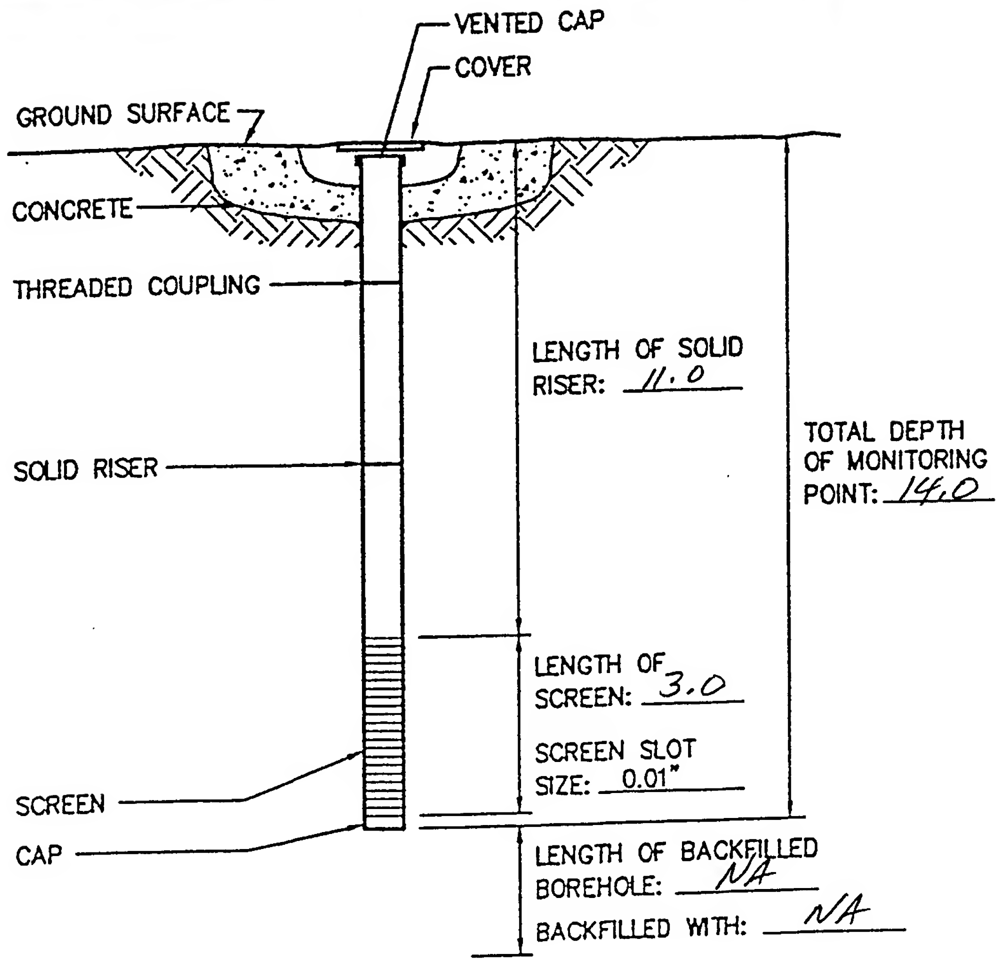
CPT-06

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER MOC-07
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION 23.99 GROUND SURFACE ELEVATION 24.24
DATUM FOR WATER LEVEL MEASUREMENT 23.99
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1½"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.

GROUND SURFACE 26.47 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

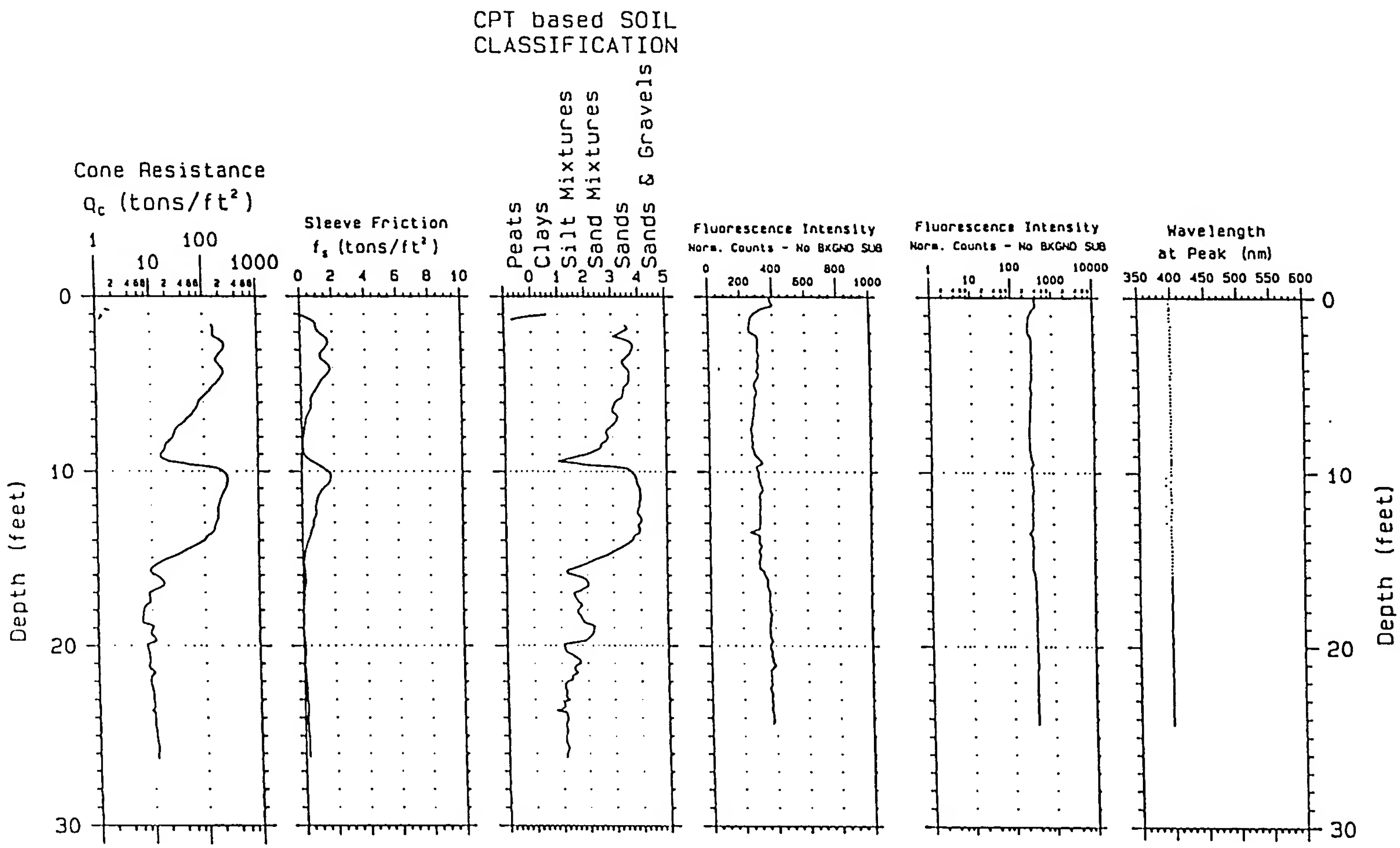
MOC-07

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 26.47

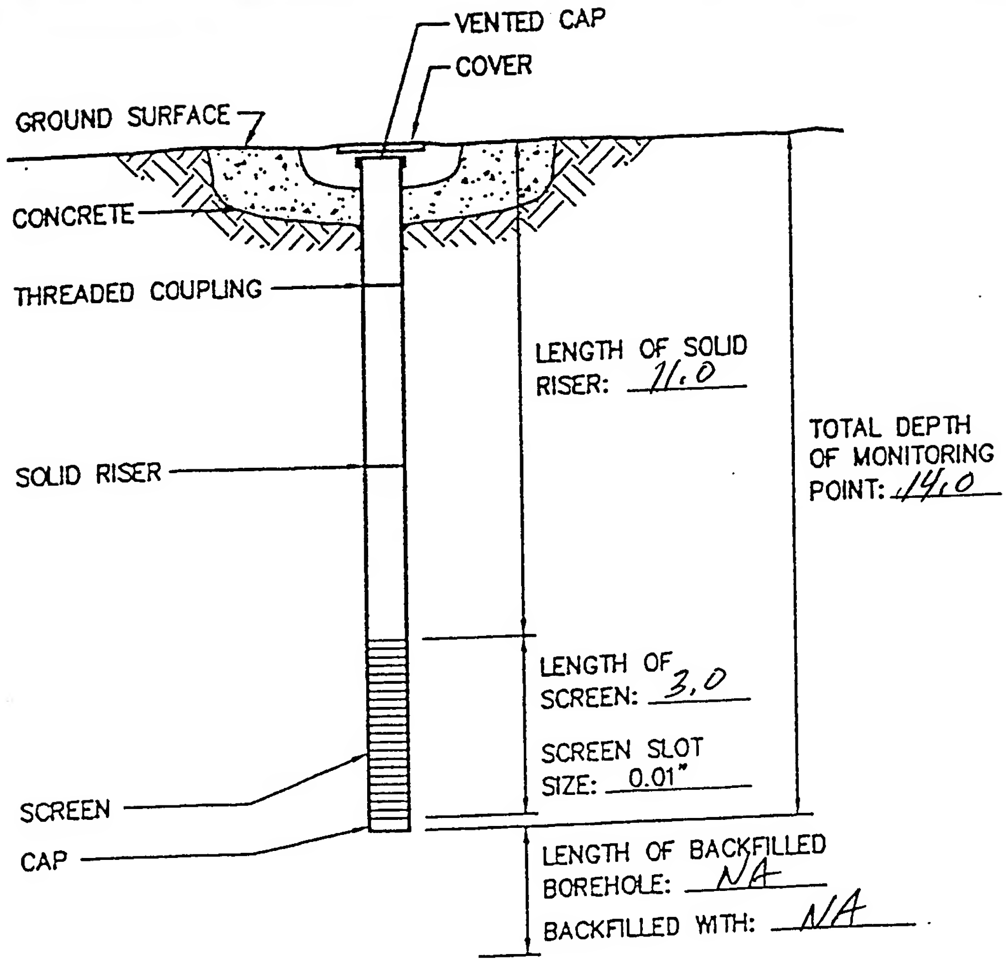
MOC-07

MOGAS SITE

Probing date; 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER MOC-08
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION 24.46 ft msl GROUND SURFACE ELEVATION 24.58 ft msl
DATUM FOR WATER LEVEL MEASUREMENT 24.46 ft msl
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.

GROUND SURFACE 26.70 FEET

DRAFT

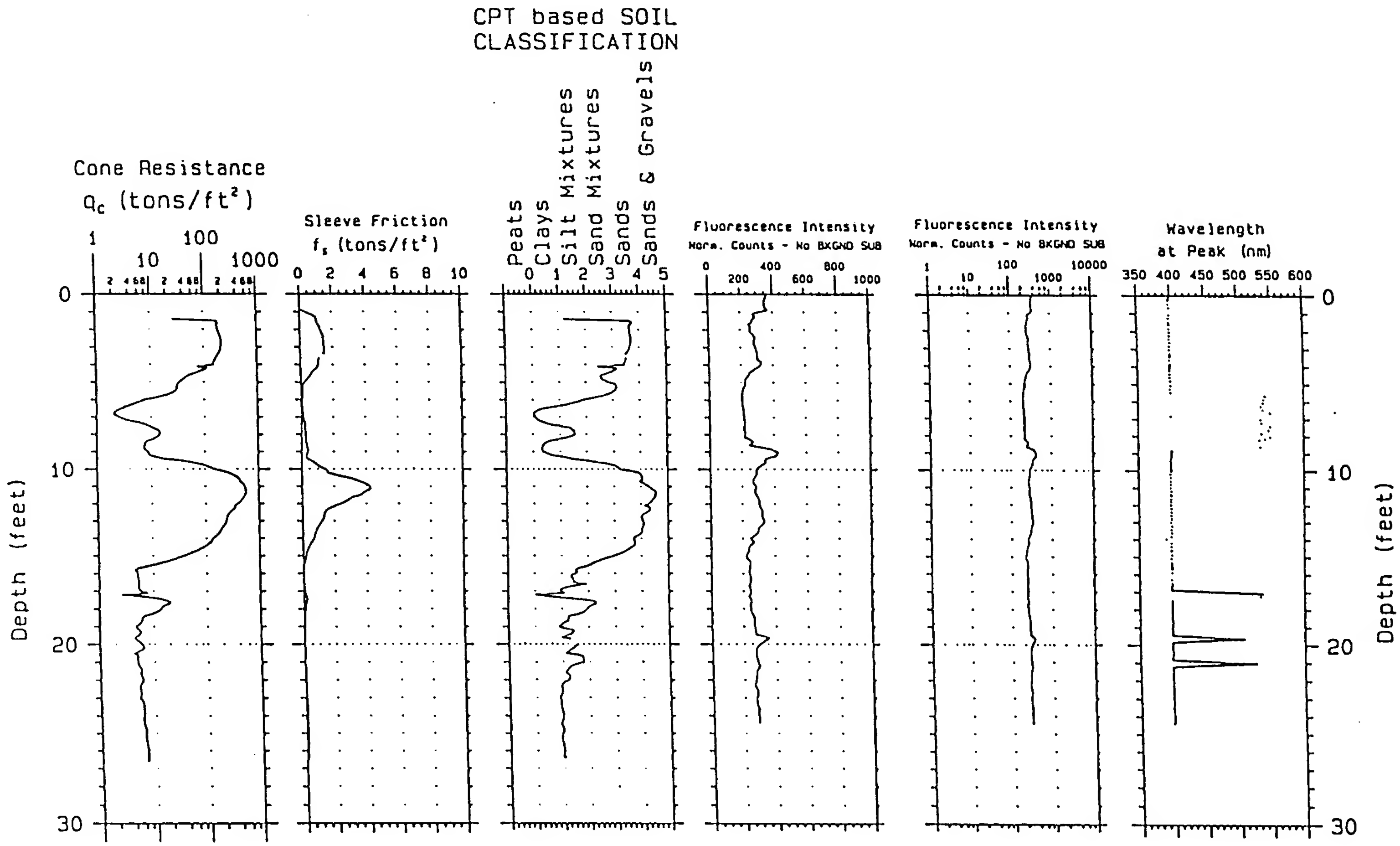
MONITORING POINT INSTALLATION RECORD

MOC-08

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 26.70

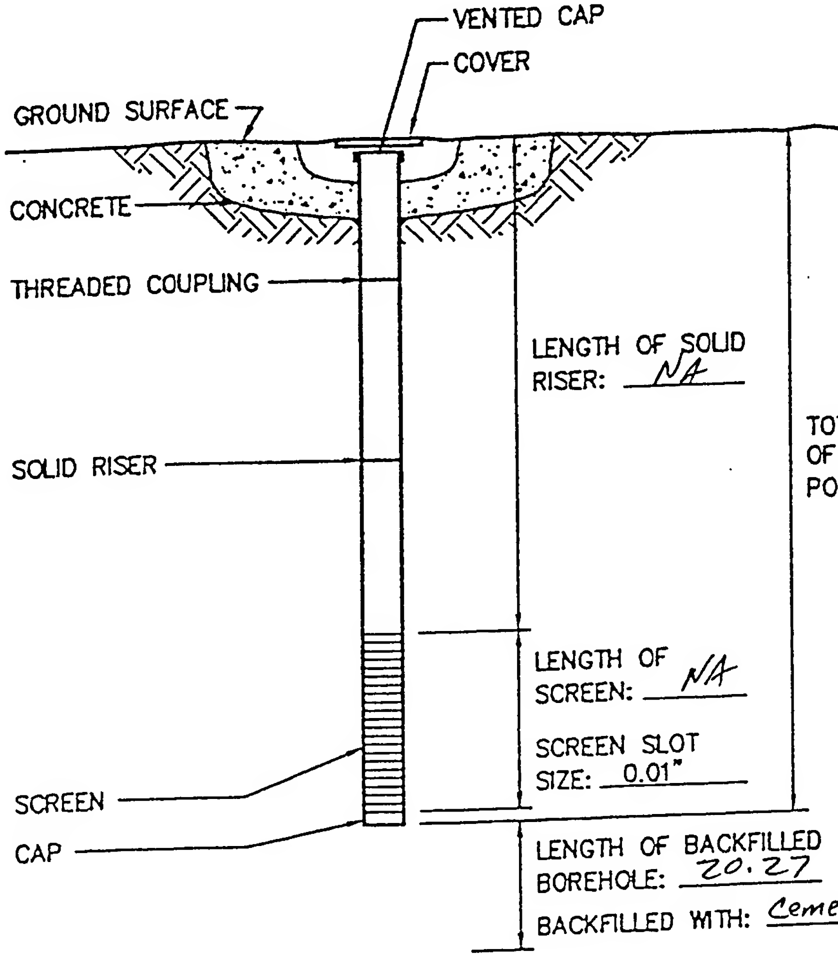
MOC-08

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME: MYRTLE BEACH – AIR FORCE BASE
MONITORING POINT NUMBER: CPT-09
JOB NUMBER: 725522
INSTALLATION DATE: 1/16/95
LOCATION: MOGAS
DATUM ELEVATION: NA
GROUND SURFACE ELEVATION: NA
DATUM FOR WATER LEVEL MEASUREMENT: NA
SCREEN DIAMETER & MATERIAL: NA
SLOT SIZE: NA
RISER DIAMETER & MATERIAL: NA
BOREHOLE DIAMETER: 1½"
CONE PENETROMETER CONTRACTOR: USACOE
ES REPRESENTATIVE: R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

GROUND SURFACE 20.27 FEET

DRAFT

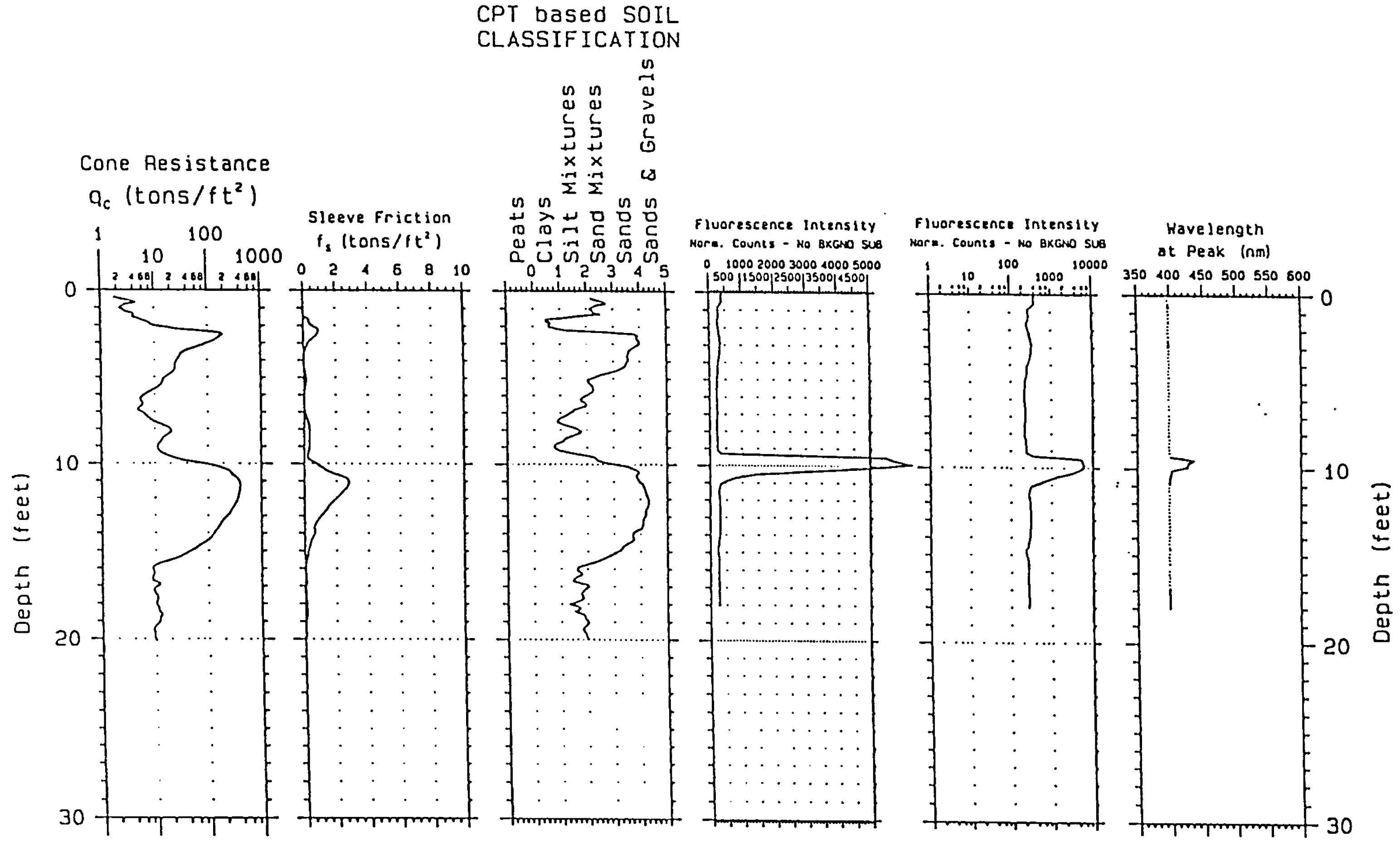
MONITORING POINT INSTALLATION RECORD

CPT-09

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 20.27

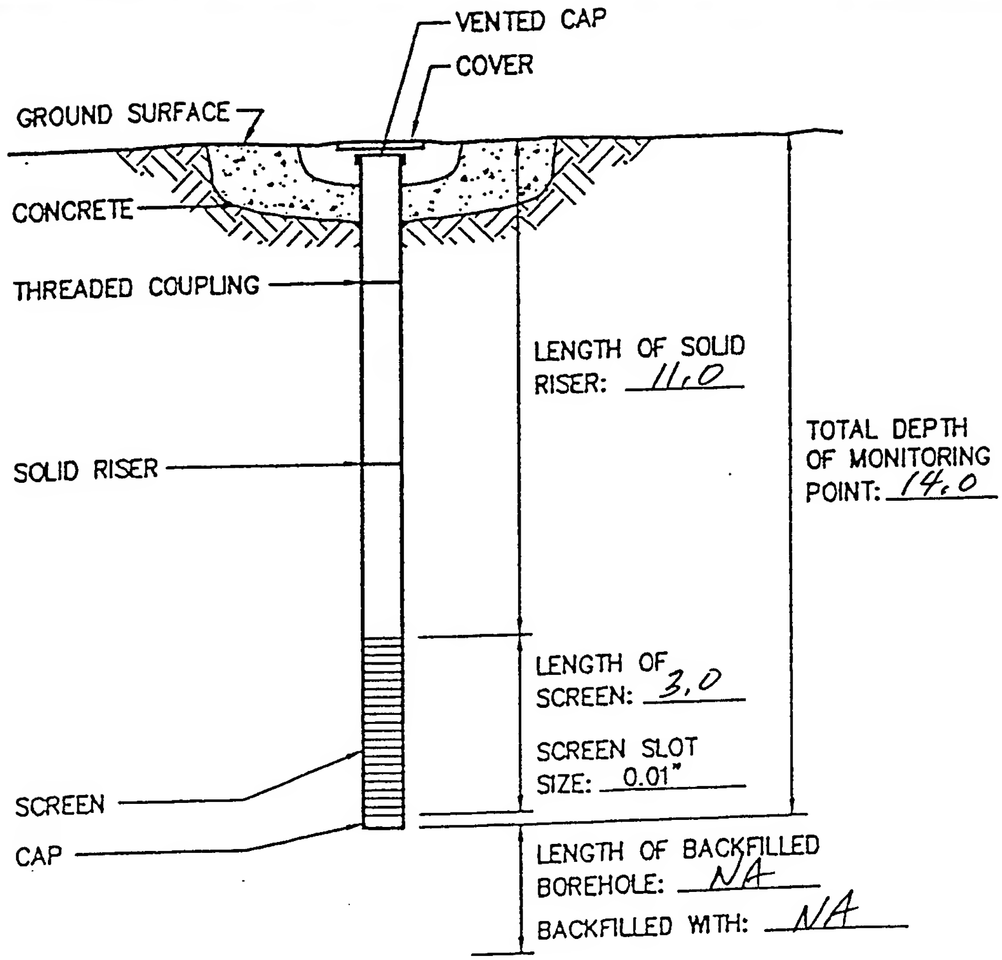
CPT-09

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER MOC-10
JOB NUMBER 725522 INSTALLATION DATE 1/16/95 LOCATION MOGAS
DATUM ELEVATION 24.74 ft msl GROUND SURFACE ELEVATION 24.89 ft msl
DATUM FOR WATER LEVEL MEASUREMENT 24.74 ft msl
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.

GROUND SURFACE 20.20 FEET

DRAFT

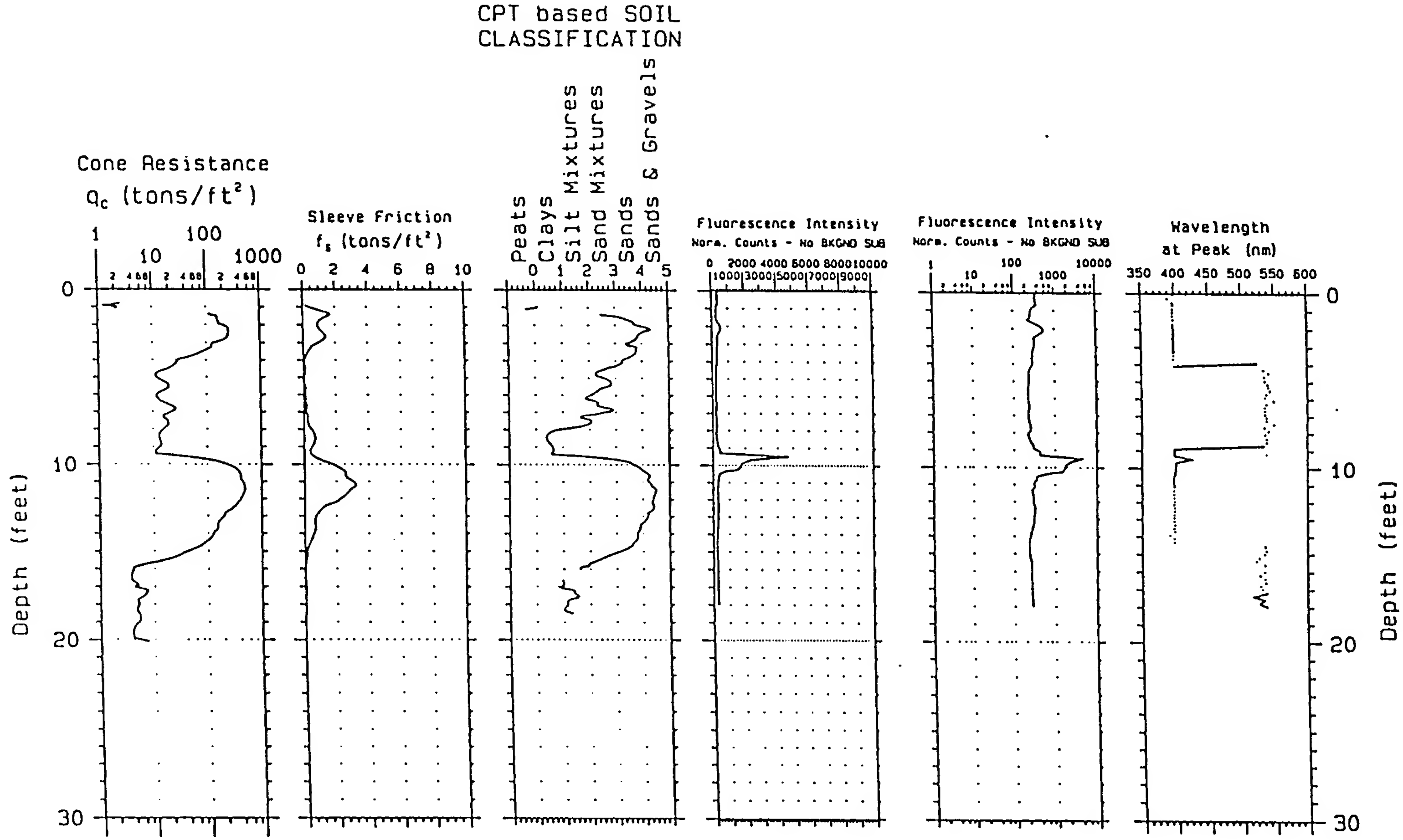
MONITORING POINT INSTALLATION RECORD

MOC-10

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 20.20

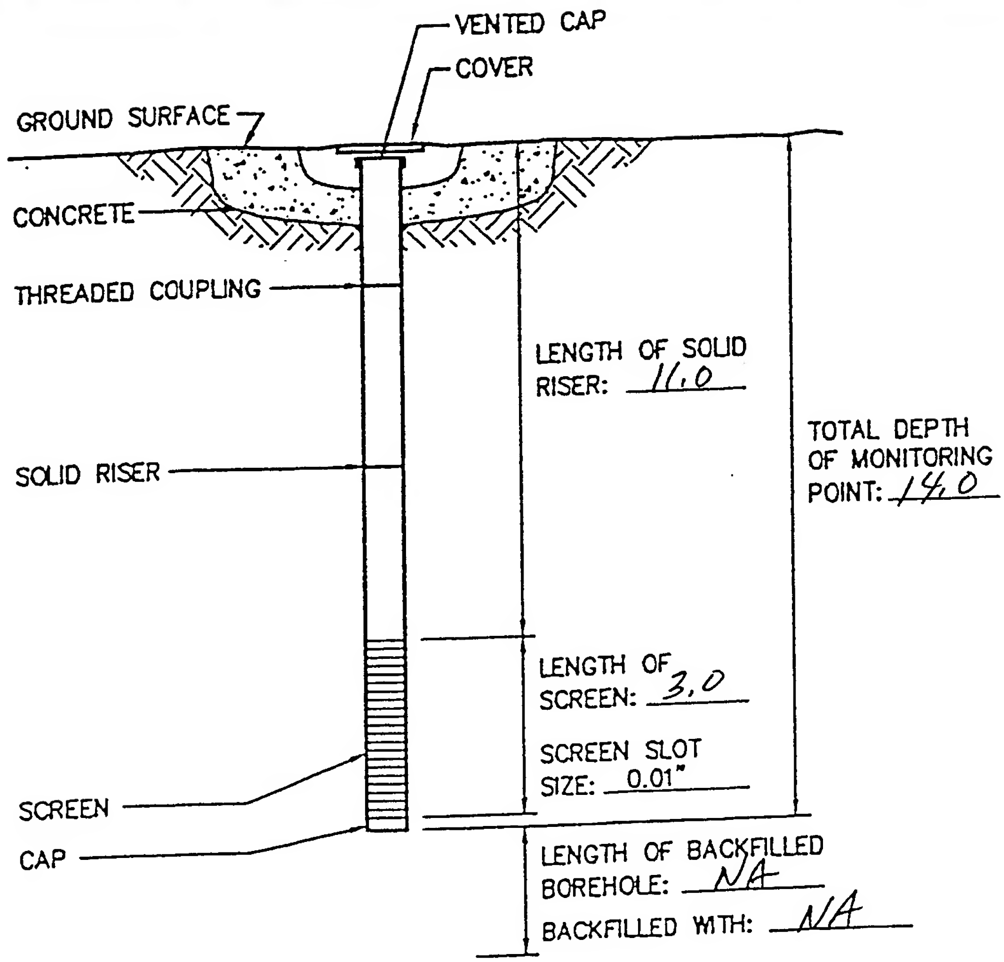
MOC-10

MOGAS SITE

Probing date: 01-16-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER MOC-11
JOB NUMBER 725522 INSTALLATION DATE 1/17/95 LOCATION MOGAS
DATUM ELEVATION 24.17 ft msl GROUND SURFACE ELEVATION 24.43 ft msl
DATUM FOR WATER LEVEL MEASUREMENT 24.17 ft msl
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1½"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.

GROUND SURFACE 29.87 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

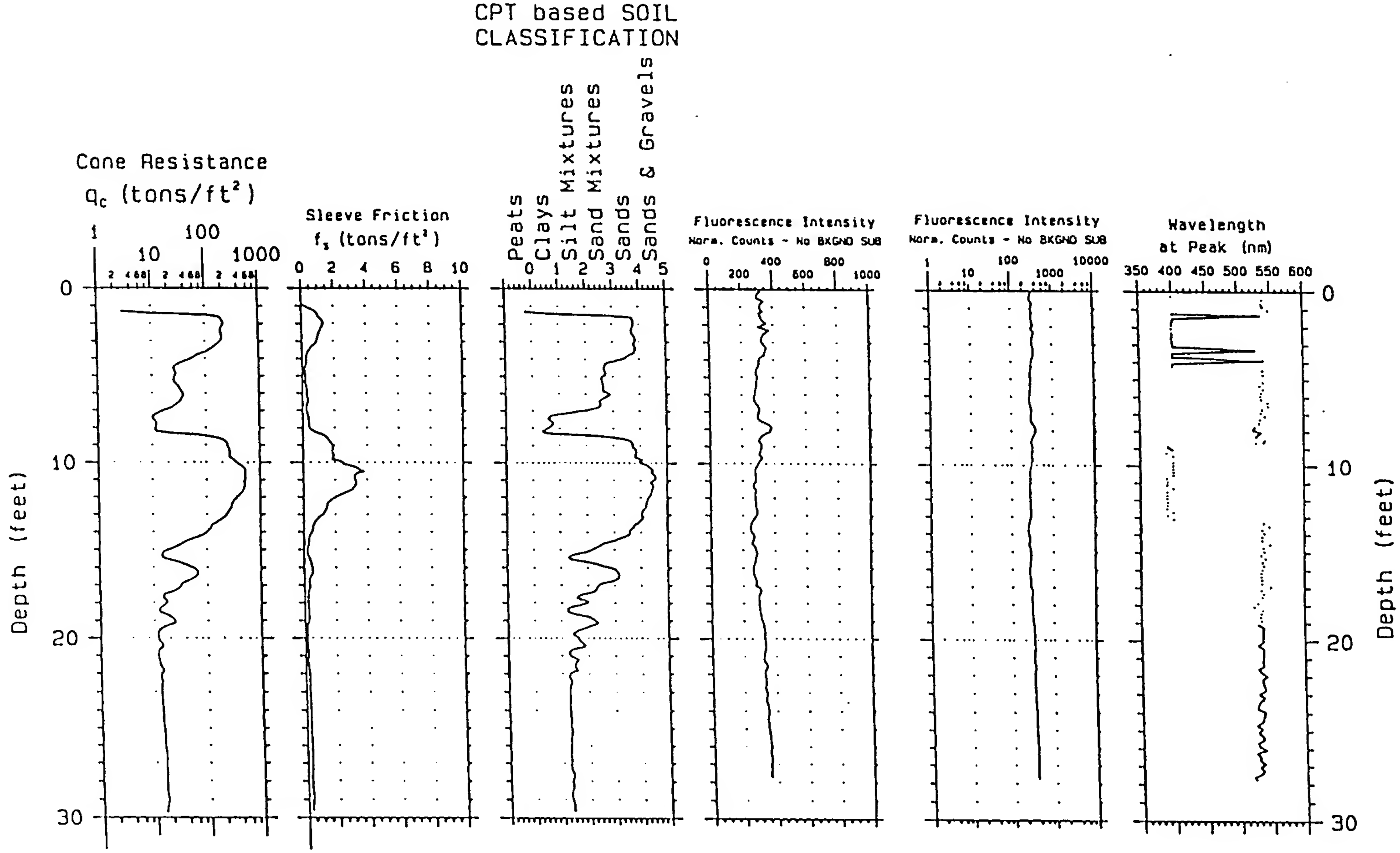
MOC-11

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 29.87

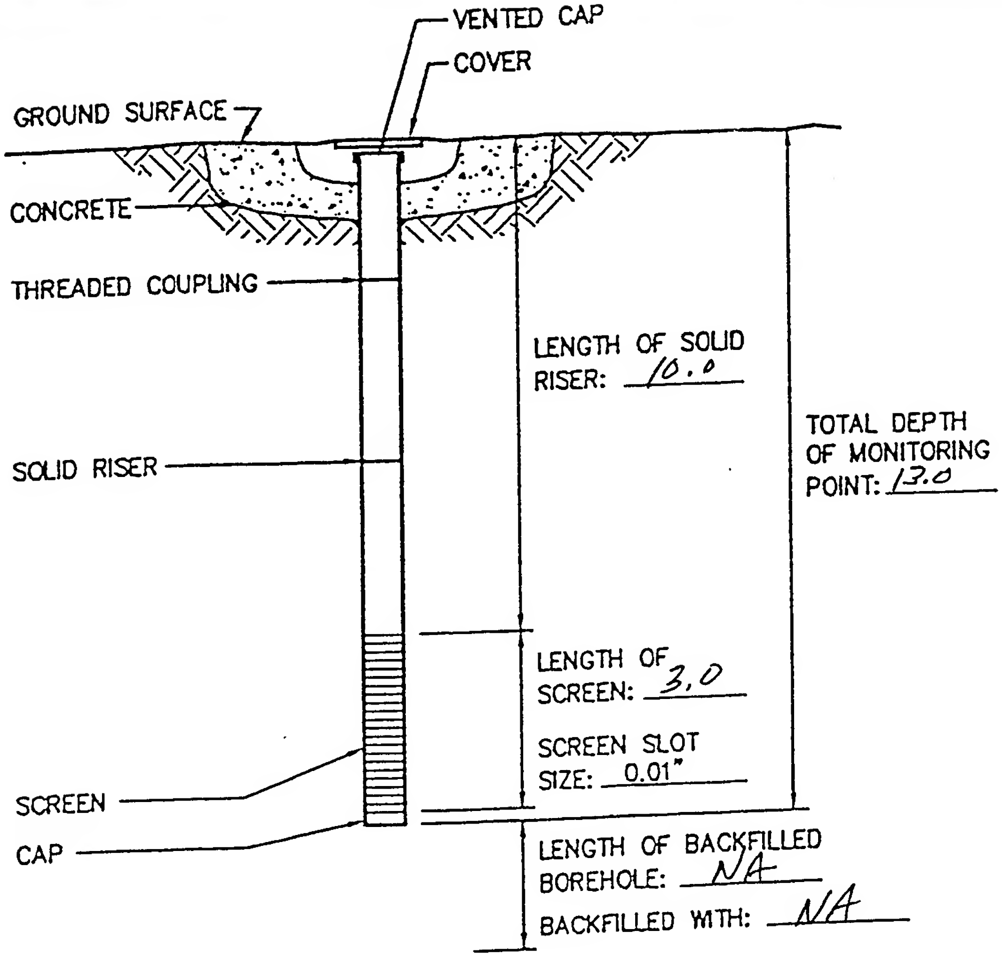
MOC-11

MOGAS SITE

Probing date; 01-17-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME: MYRTLE BEACH - AIR FORCE BASE
MONITORING POINT NUMBER: MOC-12
JOB NUMBER: 725522
INSTALLATION DATE: 1/17/95
LOCATION: MOGAS
DATUM ELEVATION: 23.11 ft msl
GROUND SURFACE ELEVATION: 23.28 ft msl
DATUM FOR WATER LEVEL MEASUREMENT: 23.11 ft msl
SCREEN DIAMETER & MATERIAL: 3/4" PVC
SLOT SIZE: 0.010"
RISER DIAMETER & MATERIAL: 3/4" PVC
BOREHOLE DIAMETER: 1 1/2"
CONE PENETROMETER CONTRACTOR: USACOE
ES REPRESENTATIVE: R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 13.0 FEET BELOW DATUM.

GROUND SURFACE 30.14 FEET

DRAFT

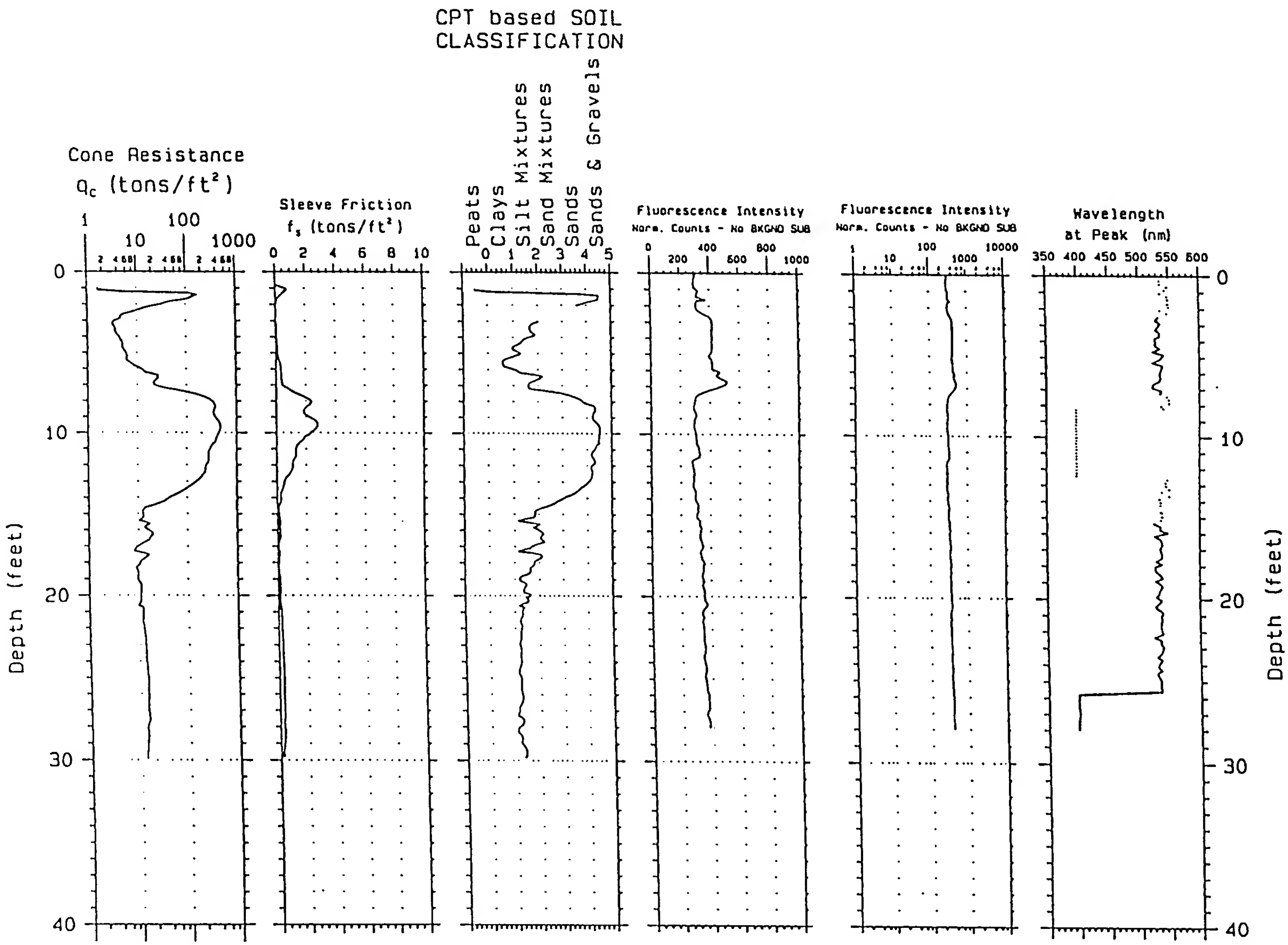
MONITORING POINT INSTALLATION RECORD

MOC-12

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

Probe Depth; 30.14

MOC-12

MOGAS SITE

Probing date: 01-17-1995

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER MOC-13

JOB NUMBER 725522 INSTALLATION DATE 1/17/95 LOCATION MOGAS

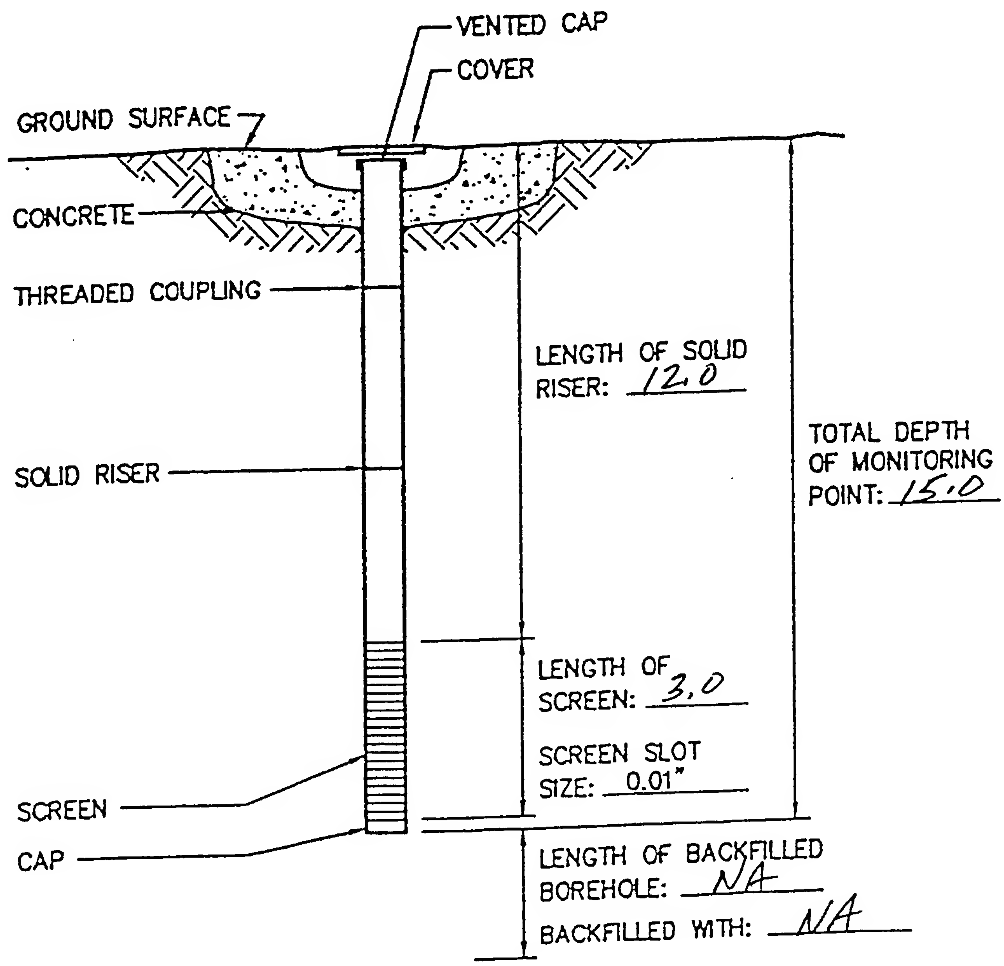
DATUM ELEVATION 21.91 ft msl GROUND SURFACE ELEVATION 22.02 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 21.91 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1½"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 15.0 FEET BELOW DATUM.

GROUND SURFACE 30.22 FEET

DRAFT

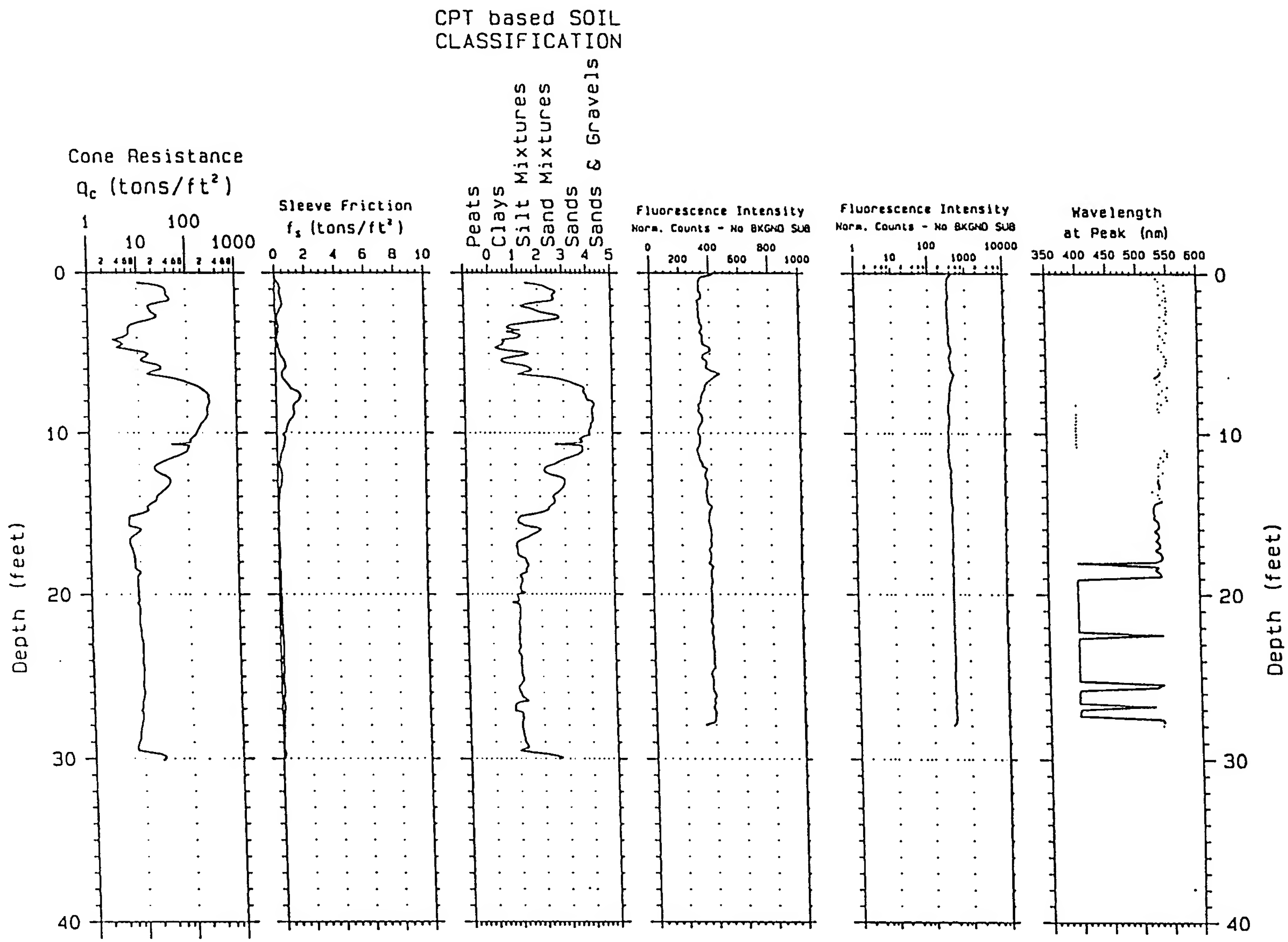
MONITORING POINT INSTALLATION RECORD

MOC-13

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Probing date: 01-17-1995

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Project; Myrtle Beach AFB

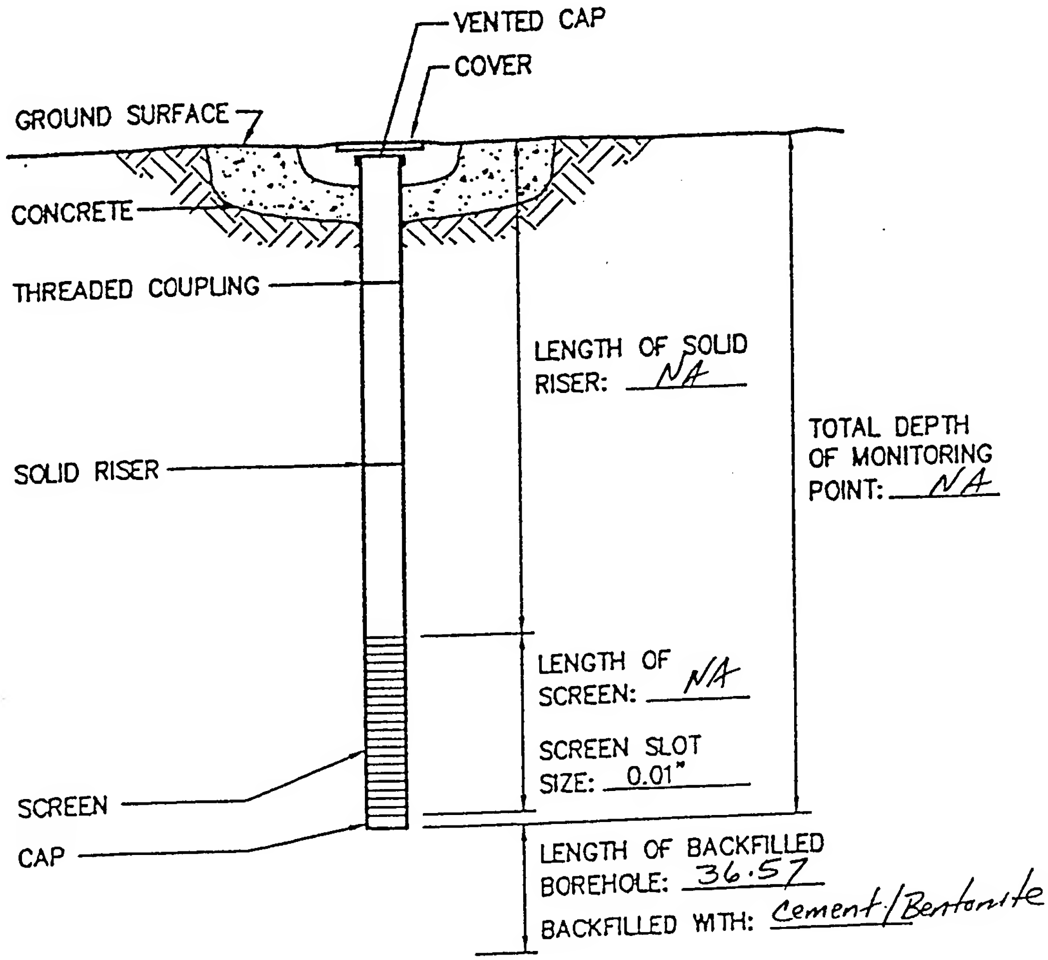
Probe Depth; 30.22

MOC-13

MOGAS SITE

MONITORING POINT INSTALLATION RECORD

JOB NAME: MYRTLE BEACH – AIR FORCE BASE
MONITORING POINT NUMBER: CPT-14
JOB NUMBER: 725522
INSTALLATION DATE: 1/17/95
LOCATION: MOGAS
DATUM ELEVATION: NA
GROUND SURFACE ELEVATION: NA
DATUM FOR WATER LEVEL MEASUREMENT: NA
SCREEN DIAMETER & MATERIAL: NA
SLOT SIZE: NA
RISER DIAMETER & MATERIAL: NA
BOREHOLE DIAMETER: 1½"
CONE PENETROMETER CONTRACTOR: USACOE
ES REPRESENTATIVE: R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

GROUND SURFACE 36.57 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

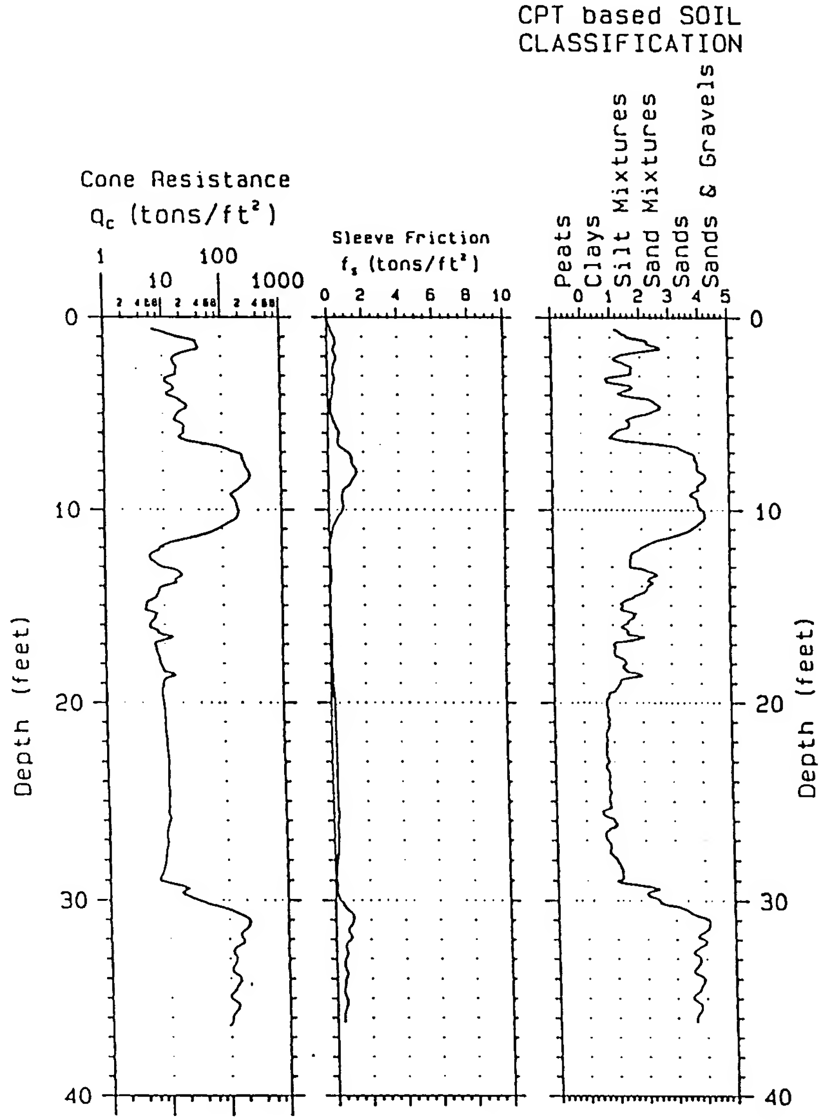
CPT-14

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Project; Myrtle Beach AFB

Probe Depth; 36.57

CPT-14

MOGAS SITE

Probing date: 01-17-1995

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER MOC-19

JOB NUMBER 725522 INSTALLATION DATE 1/18/95 LOCATION MOGAS

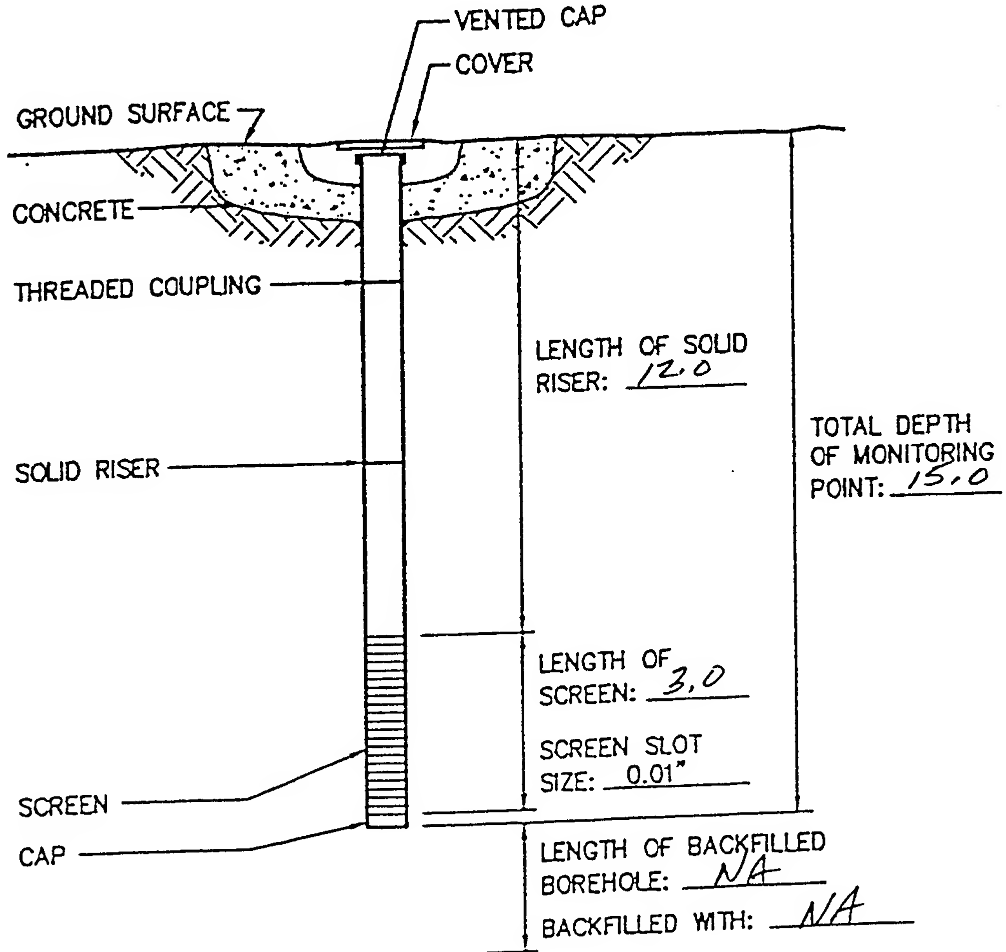
DATUM ELEVATION 22.10 ft msl GROUND SURFACE ELEVATION 22.20 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 22.10 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 15.0 FEET BELOW DATUM.

GROUND SURFACE 36.50 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

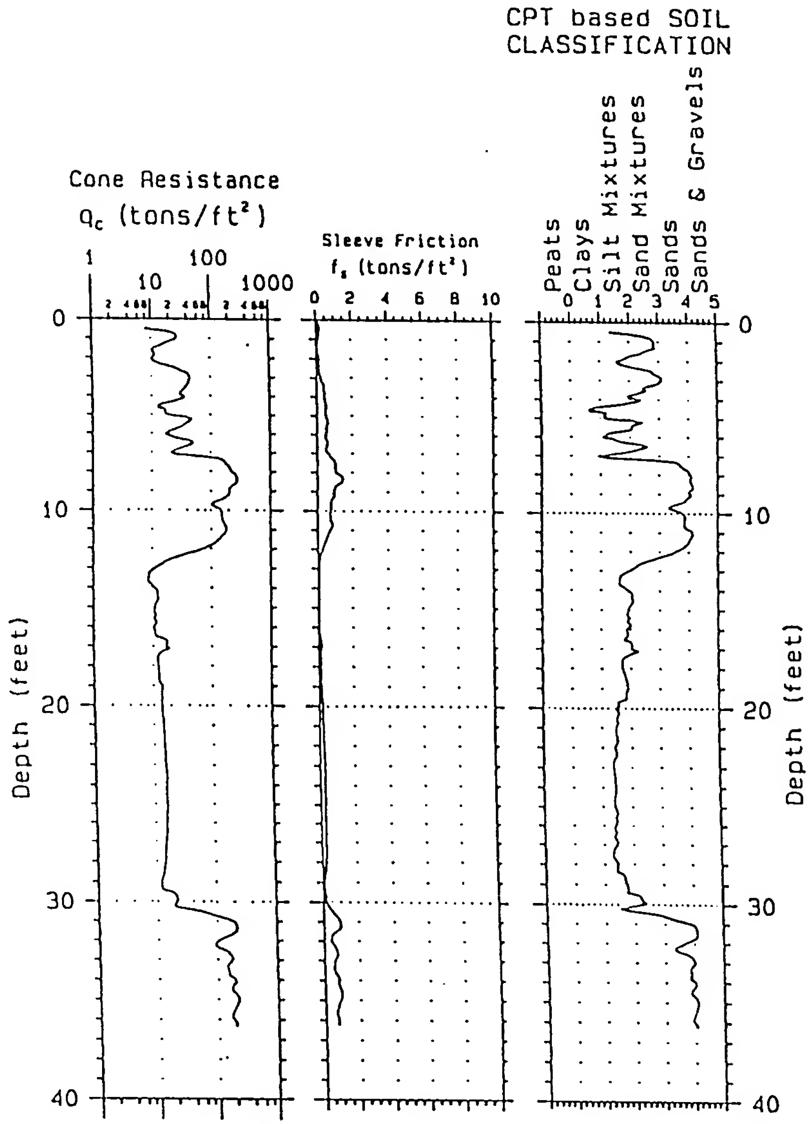
MOC-19

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado



Project; Myrtle Beach AFB
Probe Depth; 36.50
MOC-19
MOGAS SITE

Probing date: 01-18-1995

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER MOC-20

JOB NUMBER 725522 INSTALLATION DATE 1/18/95 LOCATION MOGAS

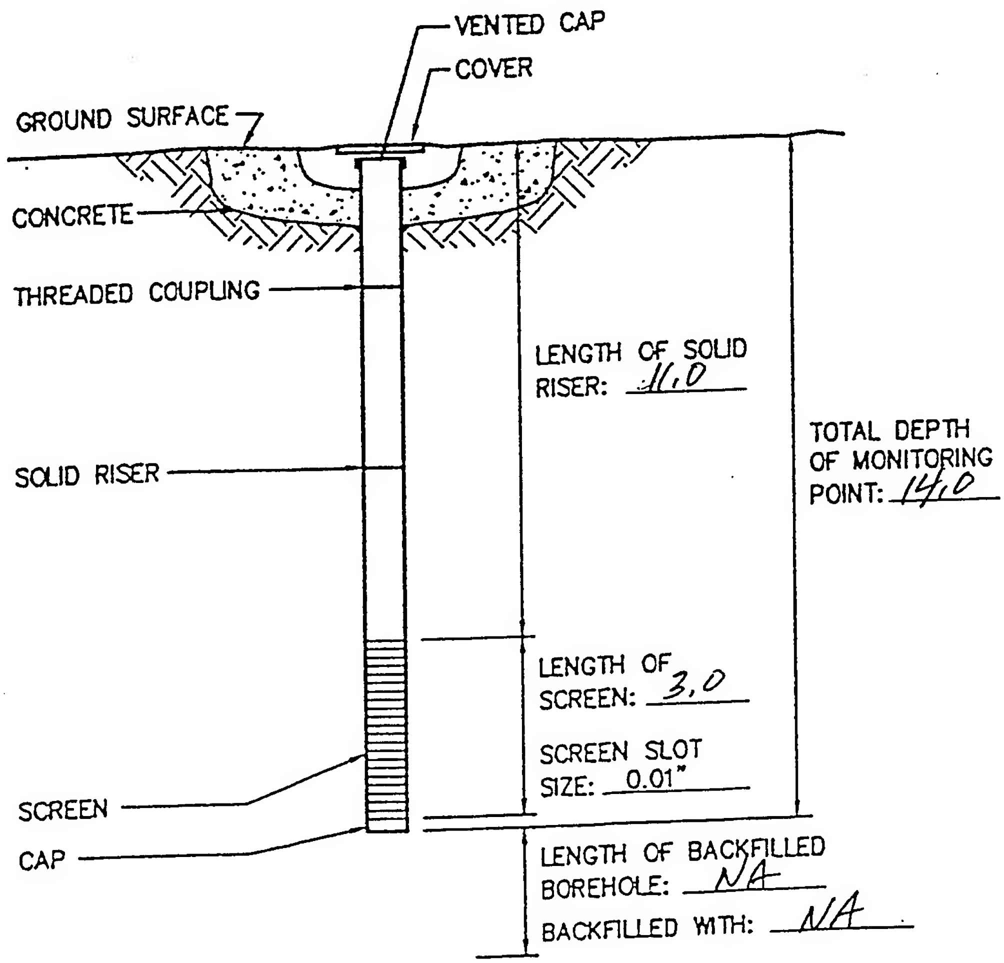
DATUM ELEVATION 23.03 ft msl GROUND SURFACE ELEVATION 23.16 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 23.03 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.

GROUND SURFACE 36.41 FEET

DRAFT

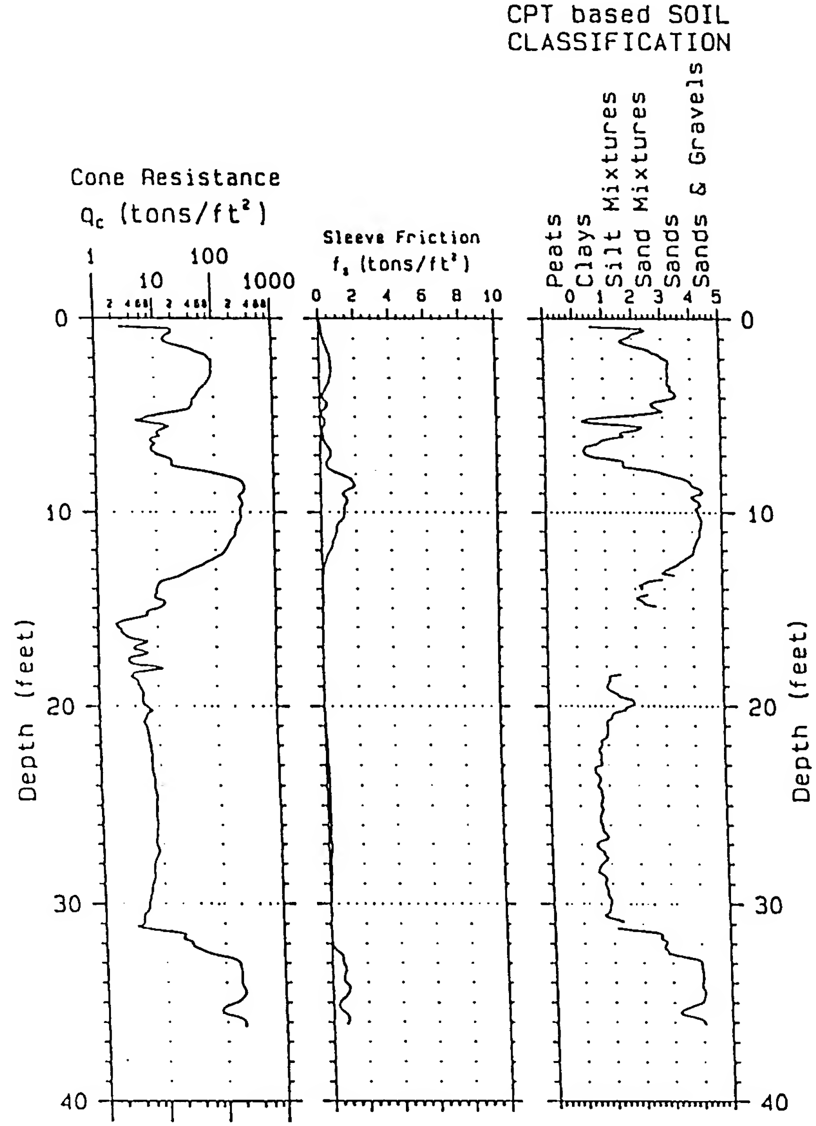
MONITORING POINT INSTALLATION RECORD

MOC-20

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Project; Myrtle Beach AFB

Probe Depth; 36.41

MOC-20

MOGAS SITE

Probing date: 01-18-1995

U.S.Army
Engineer
District
Kansas City
Geotechnical Branch

SCAPS

Site
Characterization
and Analysis
Penetrometer System

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER MOC-21

JOB NUMBER 725522 INSTALLATION DATE 1/18/95 LOCATION MOGAS

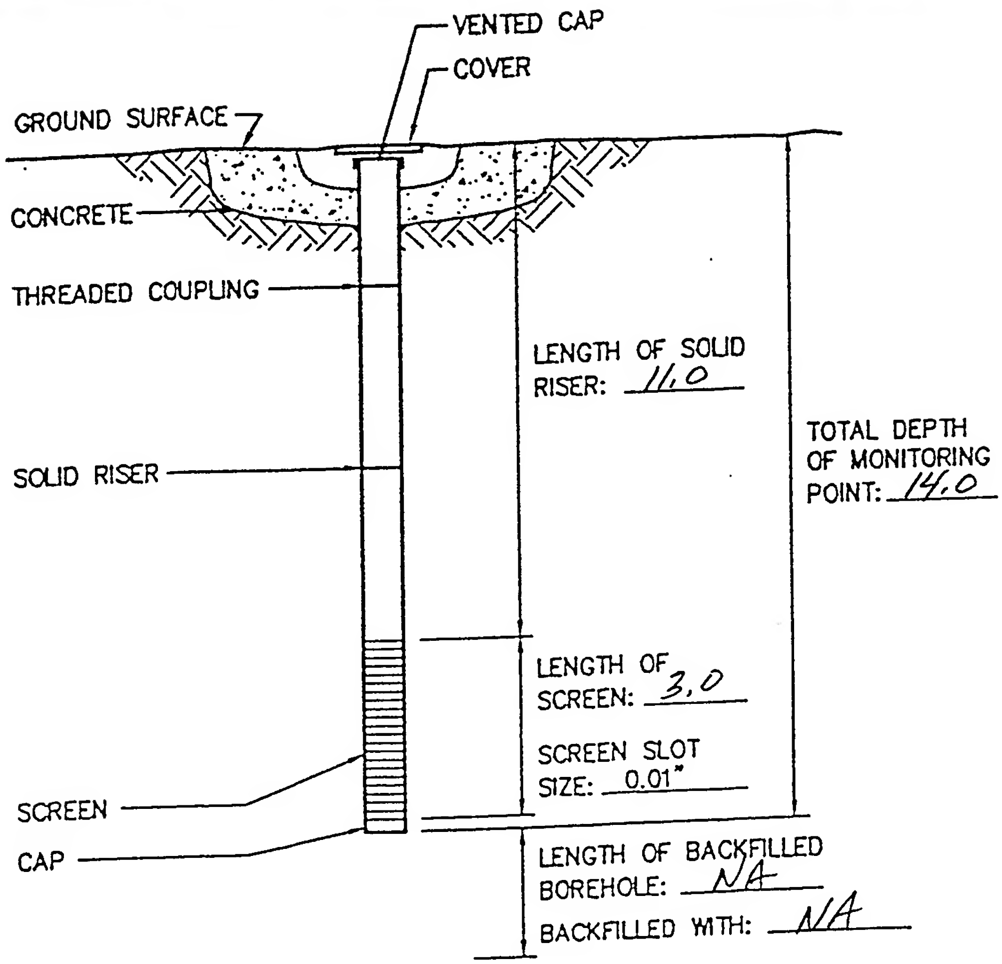
DATUM ELEVATION 21.93 ft msl GROUND SURFACE ELEVATION 22.07 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 21.93 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 14.0 FEET BELOW DATUM.

GROUND SURFACE 19.99 FEET

DRAFT

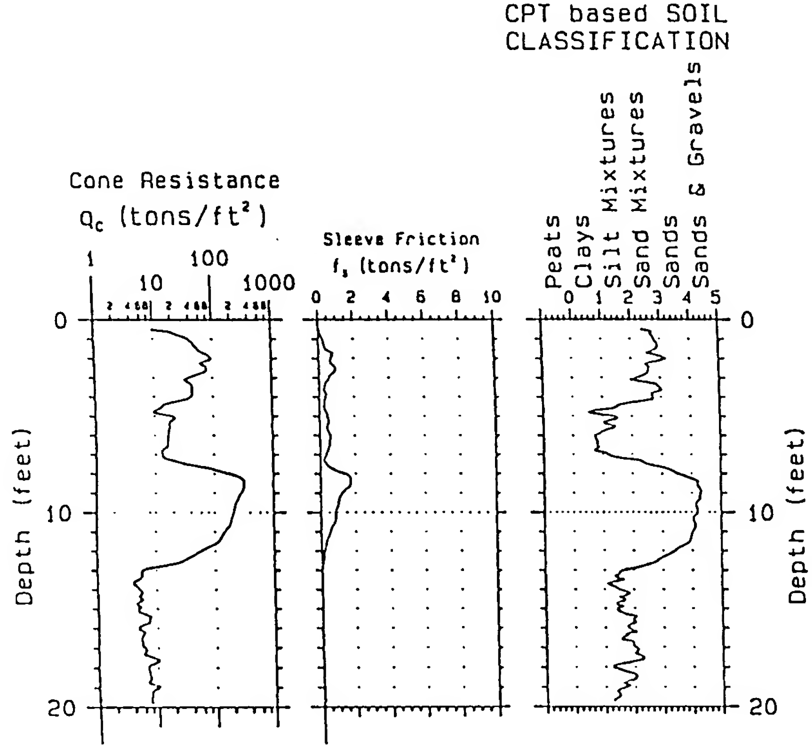
MONITORING POINT INSTALLATION RECORD

MOC-21

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



Project; Myrtle Beach AFB
Probe Depth; 19.99
MOC-21
MOGAS SITE

U.S.Army Engineer District Kansas City Geotechnical Branch

SCAPS

Site Characterization and Analysis Penetrometer System

Probing date: 01-18-1995

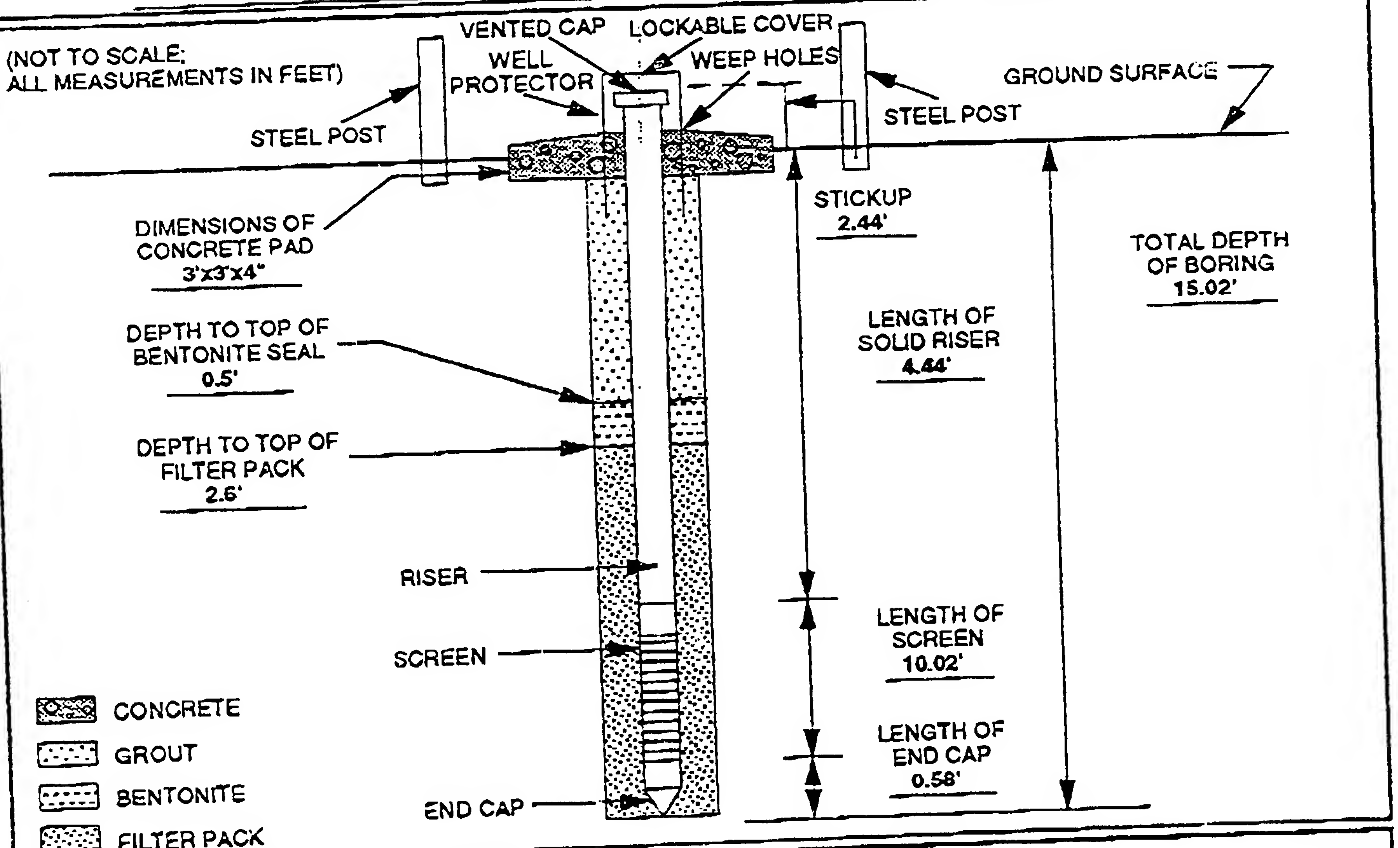
TYPE II MONITORING WELL INSTALLATION DIAGRAM

JOB NAME Myrtle Beach Air Force Base
WELL NO. MW-03 JOB NO. 11-0667
DATE 3-21-94 TIME 1700
WELL LOCATION MOGAS Area

GROUND SURFACE ELEVATION 20.87
TOP OF SCREEN ELEVATION 16.54
REFERENCE POINT ELEVATION 23.42
TYPE FILTER PACK Silica GRADATION 20 / 40
FILTER PACK MANUFACTURER Atlanta Sand and Supply
SCREEN MATERIAL Schedule 40 PVC
MANUFACTURER Brainard Kilman
SCREEN DIAMETER 2" SLOT SIZE 0.010"
RISER MATERIAL Schedule 40 PVC
MANUFACTURER Brainard Kilman
RISER DIAMETER 2"
DRILLING TECHNIQUE Hollow Stem Auger
AUGER/BIT SIZE AND TYPE 6 1/4" ID HSA

BENTONITE TYPE 3/8" Pellets
MANUFACTURER CETCO
CEMENT TYPE Portland Type 1
MANUFACTURER Holman Santee
BOREHOLE DIAMETER 8"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE S.L. Bouton
DRILLING CONTRACTOR Law Engineering
AMOUNT BENTONITE USED 50 bs.
AMOUNT CEMENT USED
AMOUNT SAND USED 500 lbs.
STATIC WATER LEVEL (> 24 hrs. after dev.) 17.30'
MEASURED ON (Date/Time)

REMARKS



QA / QC	DRILLER: J. Oglesby/R. Hooten	INSPECTOR: SLB
	DISCREPANCIES:	CHECKED BY: DATE:

0667.81

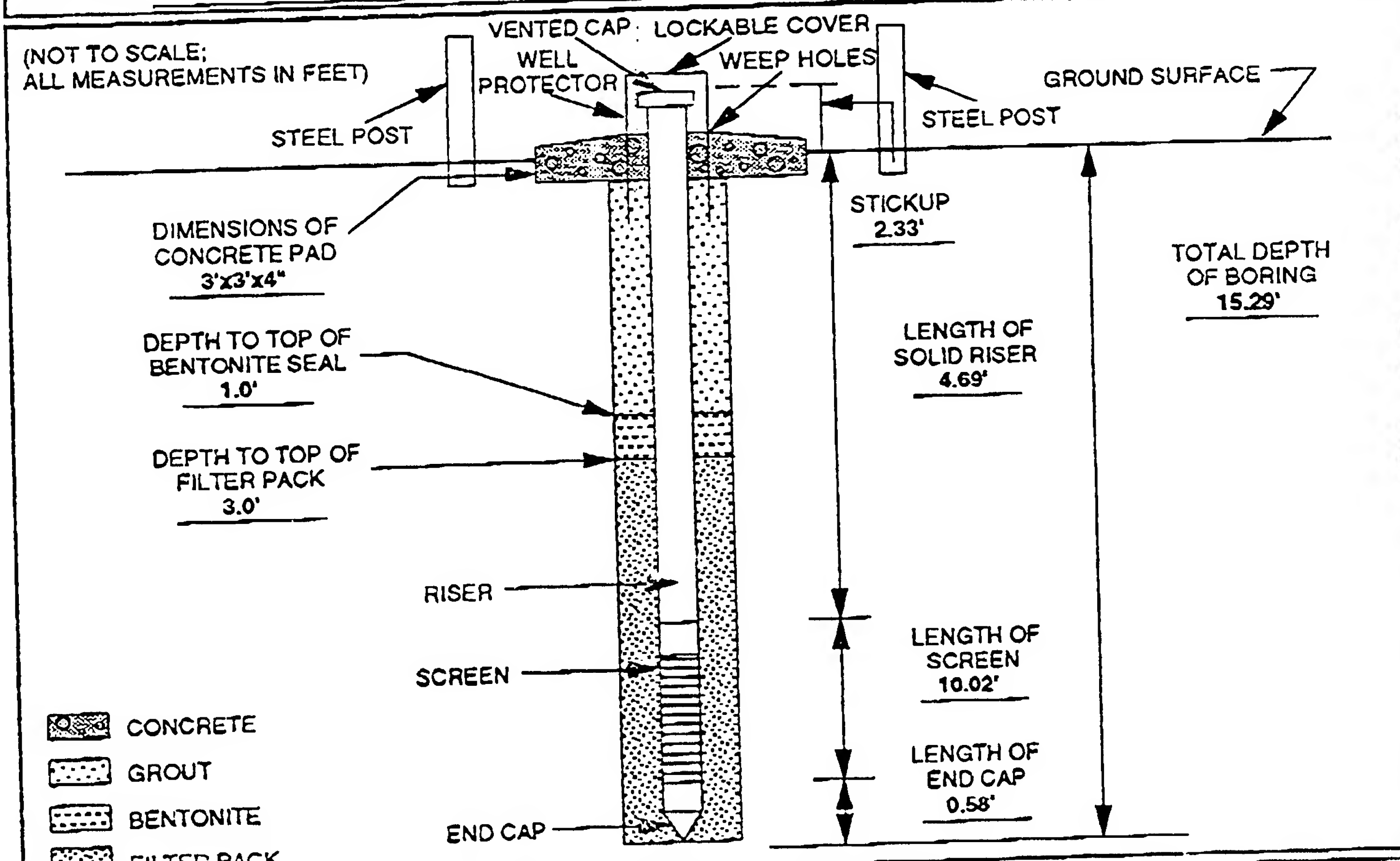
TYPE II MONITORING WELL INSTALLATION DIAGRAM

JOB NAME Myrtle Beach Air Force Base
WELL NO. MW-04 JOB NO. 11-0667
DATE 3-26-94 TIME 1030
WELL LOCATION MOGAS Area

GROUND SURFACE ELEVATION 22.35
TOP OF SCREEN ELEVATION 17.29
REFERENCE POINT ELEVATION 24.31
TYPE FILTER PACK Silica GRADATION 20 / 40
FILTER PACK MANUFACTURER Atlanta Sand and Supply
SCREEN MATERIAL Schedule 40 PVC
MANUFACTURER Brainard Kilman
SCREEN DIAMETER 2" SLOT SIZE 0.010"
RISER MATERIAL Schedule 40 PVC
MANUFACTURER Brainard Kilman
RISER DIAMETER 2"
DRILLING TECHNIQUE Hollow Stem Auger
AUGER/BIT SIZE AND TYPE 6 1/4" ID HSA

BENTONITE TYPE 3/8" Pellets
MANUFACTURER CETCO
CEMENT TYPE Portland Type 1
MANUFACTURER Holman Santee
BOREHOLE DIAMETER 8"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE E. Dolan
DRILLING CONTRACTOR Law Engineering
AMOUNT BENTONITE USED 75 bs.
AMOUNT CEMENT USED
AMOUNT SAND USED 600 lbs.
STATIC WATER LEVEL (> 24 hrs. after dev.) 9.23'
MEASURED ON (Date/Time)

REMARKS



QA / QC	DRILLER: R. Banks/J. Riley	INSPECTOR: E. Dolan	
	DISCREPANCIES:	CHECKED BY:	DATE:

0667

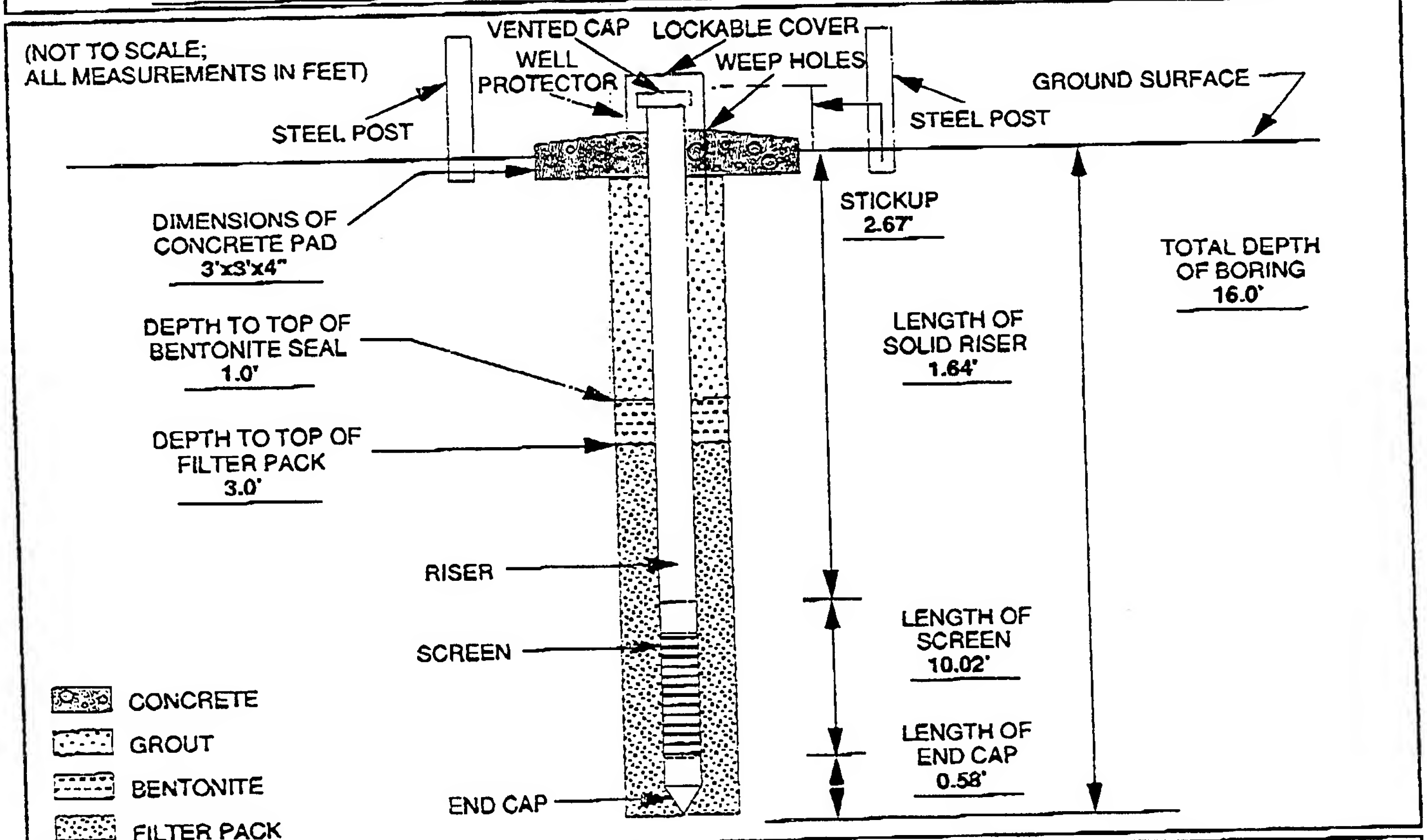
TYPE II MONITORING WELL INSTALLATION DIAGRAM

JOB NAME Myrtle Beach Air Force Base
WELL NO. MW-05 JOB NO. 11-0667
DATE 3-22-94 TIME 1030
WELL LOCATION MOGAS Area

GROUND SURFACE ELEVATION 19.79
TOP OF SCREEN ELEVATION 18.15
REFERENCE POINT ELEVATION 22.46
TYPE FILTER PACK Silica GRADATION 20 / 40
FILTER PACK MANUFACTURER Atlanta Sand and Supply
SCREEN MATERIAL Schedule 40 PVC
MANUFACTURER Brainard Kilman
SCREEN DIAMETER 2" SLOT SIZE 0.010"
RISER MATERIAL Schedule 40 PVC
MANUFACTURER Brainard Kilman
RISER DIAMETER 2"
DRILLING TECHNIQUE Hollow Stem Auger
AUGER/BIT SIZE AND TYPE 6 1/4" ID HSA

BENTONITE TYPE 3/8" Pellets
MANUFACTURER CETCO
CEMENT TYPE Portland Type 1
MANUFACTURER Holman Santee
BOREHOLE DIAMETER 8"
LAW ENVIRONMENTAL, INC.
FIELD REPRESENTATIVE E. Dolan
DRILLING CONTRACTOR Law Engineering
AMOUNT BENTONITE USED 75 bs.
AMOUNT CEMENT USED
AMOUNT SAND USED 600 lbs.
STATIC WATER LEVEL (> 24 hrs. after dev.) 9.23'
MEASURED ON (Date/Time)

REMARKS



QA / QC
DRILLER: R. Banks/J. Riley INSPECTOR: E. Dolan
DISCREPANCIES: CHECKED BY: DATE:

0667.81

Geologic Borehole and Well Completion Log

722450

Date	08/08/95 ESTDATE	Establishing Company	ESCI ESCCODE	Air Force Installation	MYRTL AFIID
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE	Location Identification	**MW-06** LOCID
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP		
Borehole Total Depth	17.00 ft. DEPTH	Construction Method	HS CMCCODE		

Completion

Elevation feet MSL

0.00

Flush-mount casing

Portland cement concrete

0.00 toc

Cement/bentonite mixture

Bentonite

2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

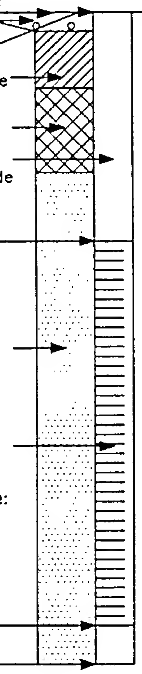
Top of screen

#10–#20 silica sand

10'x2.00" I.D. PVC (Polyvinyl Chloride (PVC)) screen, slot size: 0.020"

Base of screen

Base of casing



Sampling

Instrument Reading Penetration — SBD / SED — SMCODE — REC% (100, 50)

Instrument Reading	SBD–SED	SMCODE
pid 235.00 PPM	1.00–3.00	SS
pid 253.00 PPM	3.00–5.00	SS
pid 155.00 PPM	5.00–7.00	SS
pid 23.00 PPM	7.00–9.00	SS
pid 26.00 PPM	9.00–11.00	SS
pid 0.00 PPM	11.00–13.00	SS
pid 0.00 PPM	13.00–15.00	SS
pid 1.00 PPM	15.00–17.00	SS

Depth

feet

Ground Surface

5

10

15

Lithology

USCS Unified Soil Classification System — ASTMCODE; Lithologic Symbols & Codes — LITHCODE; STRATORDER

Description: *SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials*

ASTMCODE	Description
NACM	asphalt –PFB
SP	sand, fine–med grain, loose damp to moist, sl. odor, some coarse @ 2.5' –PFB
SP	sand, v. silty, clayey, orange & gray mottled, tr. organic mat'l, damp to moist, wet below 9' –PFB
SP	sand, med grn, well sorted, loose, sub rounded, wet, sl. odor. –PFB
SM	sand, v. silty fine–med grn, poorly sorted, no odor. –PFB

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather — Time, Equipment, Water Level –Initials

0.00' clear, hot –PFB

10.00' water @ 9–10' –PFB

MW–06
Geologic Borehole and Well Completion Log

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-81C

Geologic Borehole and Well Completion Log

722450

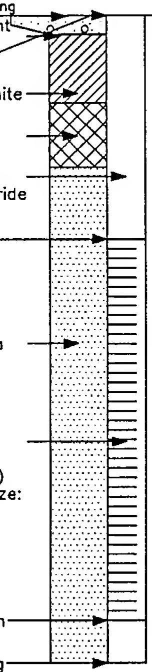
Date	08/08/95 ESTDATE	Establishing Company	ESCI ESCCODE
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE
Easting	0.00 ft. ECOORD	Drill Rig Type	mcb b-61 DRLEQP
Borehole Total Depth	17.00 ft. DEPTH	Construction Method	HS CMCCODE

Air Force Installation MYRTL AFIID
Location Identification **MW-07** LOCID

Completion

Elevation feet MSL

0.00



Flush-mount casing
Portland cement concrete 0.00 toc
Cement/bentonite mixture
Bentonite
2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing
Top of screen
#10–#20 silica sand
10'x2.00" I.D. PVC (Polyvinyl Chloride (PVC)) screen, slot size: 0.020"
Base of screen
Base of casing

Sampling

Instrument Reading Penetration; SBD / SMCODE / SED; REC% (100, 50)

Instrument Reading	SBD	SMCODE
pid 13.00 PPM	1.00	SS
pid 15.00 PPM	3.00	SS
pid 2.00 PPM	5.00	SS
pid 4.00 PPM	7.00	SS
pid 2.00 PPM	9.00	SS
pid 13.00 PPM	11.00	SS
pid 0.00 PPM	13.00	SS
pid 0.00 PPM	15.00	SS
	17.00	

Depth

feet; Ground Surface; 5, 10, 15

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description: SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials	STRATORDER
NACM		asphalt & sub base –PFB	
SP		sand, med., loose, brown, no fines, well sorted, damp, no odor –PFB	
SM		sand, silty dk olive gray, fine–med., damp, sl. odor, some black organic mat'l, becomes orange mottled below 5' –PFB	
ML		silt, clayey, sandy, gray, moist –PFB	
SP		sand, med–grained, loose, well sorted, tr. fines, gray, no odor, wet @ about 9.5' –PFB	

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather; Time, Equipment, Water Level –Initials

0.00' clear, hot –PFB

10.00' water @ 9.5–10' –PFB

MYRTL MW-07 TD 17.00' 1"=5.00' 1:60.00 960321 1337 Sheet 1 of 1

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-07
Geologic Borehole and Well Completion Log

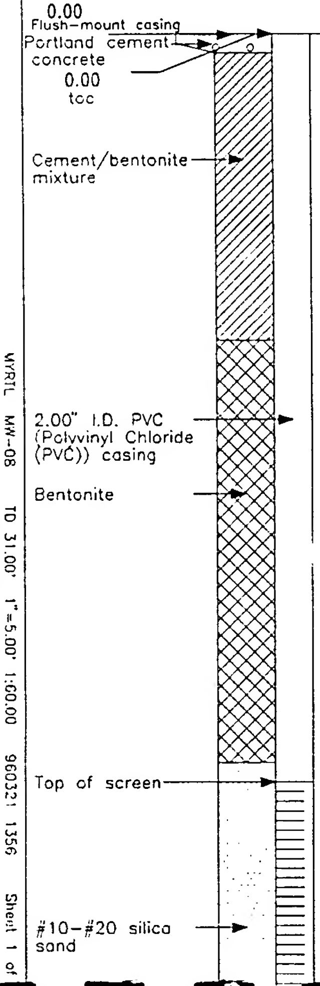
Geologic Borehole and Well Completion Log

722450

Date	08/08/95	ESTDATE	Establishing Company	ESCI	ESCCODE			
Northing	0.00 ft.	NCOORD	Drilling Company	ALL	DRLCODE	Air Force Installation	MYRTL	AFIID
Easting	0.00 ft.	ECOORD	Drill Rig Type	mob b-61	DRLEQP	Location Identification	**MW-08**	LOCID
Borehole Total Depth	31.00 ft.	DEPTH	Construction Method	HS	CMCCODE			

Completion

Elevation feet MSL



Sampling

Instrument Reading Penetration	SBD / SED	SMCODE	REC%
	0.00		
pid 1.00 PPM	1.00	SS	
pid 1.00 PPM	3.00	SS	
pid 1.00 PPM	5.00	SS	
pid 1.00 PPM	7.00	SS	
pid 1.00 PPM	9.00	SS	
pid 1.00 PPM	11.00	SS	
pid 1.00 PPM	13.00	SS	
pid 1.00 PPM	15.00	SS	
pid 5.00 PPM	17.00	SS	
pid 0.00 PPM	19.00	SS	
pid 1.00 PPM	21.00	SS	
pid 4.00 PPM	23.00	SS	

Depth

feet — Ground Surface — 5 — 10 — 15 — 20 — 25

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description *SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials*	STRATORDER
NACM		Asphalt & sub base –PFB	
SM		sand, silty, topsoil, ··ls of organics –PFB	
SM		sand, fine–med, well sorted, damp, no odor –PFB	
SM		sand, silty fine–med, well sorted, damp, no odor, becomes very silty below 6', damp to moist no odor –PFB	
SP		sand, loose medium, well sorted, tr. silt, moist, wet @ 9', gray color color turns brownish gray below 10.5' below 13' sand size decreases to fine–med, dk gray color tr. silt, shells present in fine sand matrix @ 16.7 –PFB	
ML		silt, fine–v. fine sandy, dk gray, with abundant shell fragments becomes increasingly clayey with depth shell fragments decrease to trace below 29.5' –PFB	

Remarks

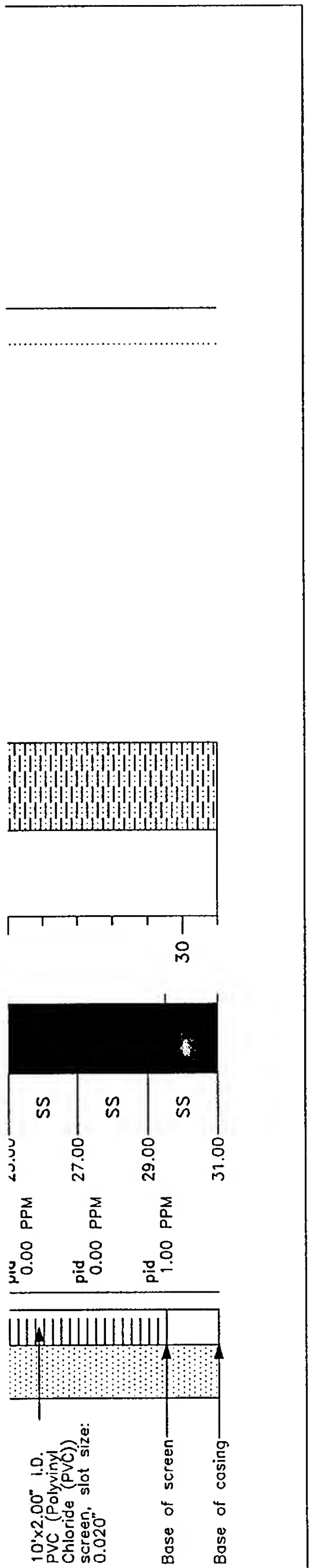
Depth Borehole Diameter Drilling Problems Weather — *Time Equipment Water Level –Initials*

0.00' 8" borehole, p. cldy, hot –PFB

MYRTL MW-08 TD 31.00' 1"=5.00' 1:60.00 960321 1356 Sheet 1 of

MW-08
Geologic Borehole and Well Completion Log

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100



MW-08

Geologic Borehole and Well Completion Log *(continued)*

Geologic Borehole and Well Completion Log

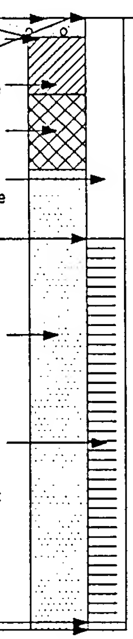
722450

Date	08/08/95 ESTDATE	Establishing Company	ESCI ESCCODE	Air Force Installation	MYRTL AFIID
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE	Location Identification	**MW-09** LOCID
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP		
Borehole Total Depth	16.00 ft. DEPTH	Construction Method	HS CMCCODE		

Completion

Elevation feet MSL

0.00



- Flush-mount casing
- Portland cement concrete
- 0.00 toc
- Cement/bentonite mixture
- Bentonite
- 2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing
- Top of screen
- #10–#20 silica sand
- 10'x2.00" I.D. PVC (Polyvinyl Chloride (PVC)) screen, slot size: 0.020"
- Base of screen
- Base of casing

Sampling

Instrument Reading Penetration	SBD / SED	SMCODE	REC%
pid 1.00 PPM	1.00	SS	
pid 1.00 PPM	3.00	SS	
pid 1.00 PPM	5.00	SS	
pid 1.00 PPM	7.00	SS	
pid 1.00 PPM	9.00	SS	
pid 1.00 PPM	11.00	SS	
pid 1.00 PPM	13.00	SS	
	15.00		

Depth

feet — Ground Surface — 5, 10, 15

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description: SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials	STRATORDER
NACM		asphalt &sub base –PFB	
SM		sand, silty, topsoil w/ lots organics –PFB	
SP		sand, fine-med., damp, no odor –PFB	
SM		sand, fine-med., damp, no odor –PFB	
SP		sand, loose, med., well sorted, tr. silt, moist, wet @ 9', gray color color becomes brownish gray below 10.5' below 13' sand size decreases –PFB	

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather — Time, Equipment, Water Level –Initials

0.00' p. cldy, hot –PFB

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-09
Geologic Borehole and Well Completion Log

Geologic Borehole and Well Completion Log

722450

Date	08/08/95	ESTDATE	Establishing Company	ESCI	ESCCODE			
Northing	0.00 ft.	NCOORD	Drilling Company	ALL	DRLCODE	Air Force Installation	MYRTL	AFIID
Easting	0.00 ft.	ECOORD	Drill Rig Type	mob b-61	DRLEQP	Location Identification	**MW-10**	LOCID
Borehole Total Depth	17.00 ft.	DEPTH	Construction Method	HS	CMCCODE			

Completion

Elevation feet MSL

0.00

Flush-mount casing

Portland cement concrete

0.00 toc

Cement/bentonite mixture

Bentonite

2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

Top of screen

#10-#20 silica sand

10'x2.00" I.D. () screen, slot size: 0.020"

Base of screen

Base of casing

Sampling

Instrument Reading Penetration · SBD · SMCODE · SED · REC% (100, 50)

Instrument Reading	SBD	SMCODE
pid 6.00 PPM	1.00	SS
pid 1.00 PPM	3.00	SS
pid 1.00 PPM	5.00	SS
pid 0.00 PPM	7.00	SS
pid 3.00 PPM	9.00	SS
pid 5.00 PPM	11.00	SS
pid 13.00 PPM	13.00	SS
pid 18.00 PPM	15.00	SS
	17.00	

Depth

feet

Ground Surface

5, 10, 15

Lithology

USCS Unified Soil Classification System ASTMCODE	Description: *SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. -Initials*	STRATORDER
NACM	asphalt & sub base -PFB	
SP	sand, loose, brown, well sorted, tr. silt, color becomes gray/orange mottled, sand size decreases below 3' -PFB	
SM	sand, silty, mollted olive gray and orange color, damp to moist, v. silty below 7'. -PFB	
ML	silt, fine sandy, gray & orange mottled.-PFB	
SP	sand, loose, medium, well sorted, gray, wet, no odor, some silty sand @ 11.5', sulfurous odor, color becomes dk. gray @ 13'. -PFB	
SM	sand, silty, fine-med., dk gray. -PFB	
SP	sand, loose, med., sub rounded. -PFB	

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather — Time, Equipment, Water Level -Initials

0.00' p. cldy, hot -PFB

MYRTL MW-10 TD 17.00' 1"=5.00' 1:60.00 960321 1441 Sheet 1 of 1

MW-10
Geologic Borehole and Well Completion Log

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado
(303) 831-8100

Geologic Borehole and Well Completion Log

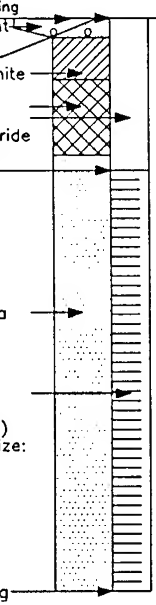
722450

Date	08/09/95 ESTDATE	Establishing Company	ESCI ESCCODE	Air Force Installation	MYRTL AFIID
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE	Location Identification	**MW-11** LOCID
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP		
Borehole Total Depth	15.00 ft. DEPTH	Construction Method	HS CMCCODE		

Completion

Elevation feet MSL

0.00



Sampling

Instrument Reading Penetration	SBD / SED	SMCODE
pid 0.00 PPM	1.00–3.00	SS
pid 0.00 PPM	3.00–5.00	SS
pid 0.00 PPM	5.00–7.00	SS
pid 49.00 PPM	7.00–9.00	SS
pid 3.00 PPM	9.00–11.00	SS
pid 0.00 PPM	11.00–13.00	SS
pid 4.00 PPM	13.00–15.00	SS

REC% (100, 50)

Depth

feet

Ground Surface

5 10 15

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description: SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. -*Initials*	STRATORDER
SP		sand, brown, tr. silt, topsoil. -PFB	
SM		sand, silty, fine to medium, gray, gray & orange mottled, dry to damp, no odor, silt content increases w/ depth to nearly 50%. -PFB	
SP		sand,loose, medium, gray, wet, no odor, little to no fines, well sorted, sub-rnd., color becomes dk. gray below 9'. -PFB	
ML		silt, fine sandy, dk gray, no odor. -PFB	
SP		sand, med., loose, tr. silt. -PFB	

Remarks

Depth Borehole Diameter Drilling Problems Weather — *Time Equipment Water Level -Initials*

0.00' clear, hot -PFB

MYRTL MW-11 TD 15.00' 1"=5.00' 1:60.00 960321 1451 Sheet 1 of

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-11
Geologic Borehole and Well Completion Log

Geologic Borehole and Well Completion Log

722450

Date	08/09/95 ESTDATE	Establishing Company	ESCI ESCCODE	Air Force Installation	MYRTL AFIID
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE	Location Identification	**MW-12** LOCID
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP		
Borehole Total Depth	35.00 ft. DEPTH	Construction Method	HS CMCCODE		

Completion

Elevation feet MSL

0.00

Flush-mount casing

Portland cement

concrete

0.00 toc

Cement/bentonite mixture

2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

Sampling (Instrument Reading Penetration; SBD, SED; SMCODE; REC% 100 50)

Instrument Reading	SBD	SMCODE
pid 0.00 PPM	1.00	SS
pid 0.00 PPM	3.00	SS
pid 0.00 PPM	5.00	SS
pid 1.00 PPM	7.00	SS
pid 0.00 PPM	9.00	SS
pid 2.00 PPM	11.00	SS
pid 0.00 PPM	13.00	SS
pid 1.00 PPM	15.00	SS
pid 0.00 PPM	17.00	SS
pid 0.00 PPM	19.00	SS
pid 0.00 PPM	21.00	SS
pid 0.00 PPM	23.00	SS
		SS

Depth feet — Ground Surface — 5 — 10 — 15 — 20 — 25

Lithology

USCS Unified Soil Classification System ASTMCODE	Description: SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. —*Initials*
SP	sand, topsoil, dk. brn., dry —PFB
SM	sand, silty, fine-medium, olive gray and orange mottling, damp to moist, no odor. —PFB
ML	silt, fine sandy, clayey, gray, moist. —PFB
SP	sand, loose, medium, silty in upper part, lt. gray, moist, no odor, wet @ 8', becomes dk. gray below 10'. —PFB
ML	silt, fine sandy, clayey, dk. gray, no odor, 2"-3" thick layers with abundent shell fragments @ 16.2', 17.3', 18.5', shell fragments are less abundent below 23'. —PFB

Lithologic Symbols & Codes LITHCODE

STRATORDER

Remarks

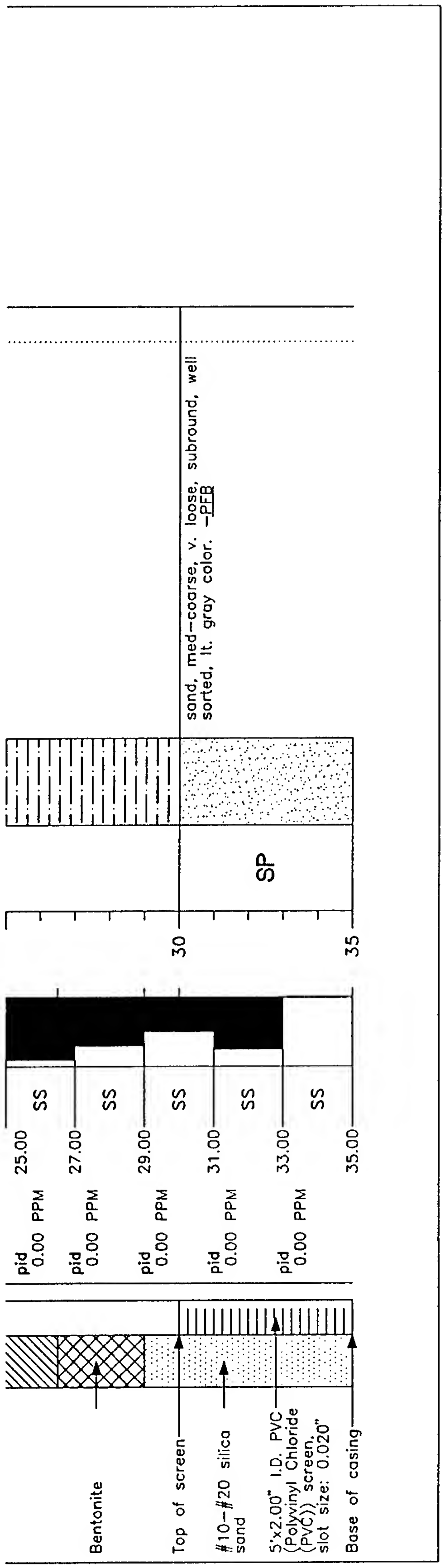
Depth
Borehole Diameter
Drilling Problems
Weather

Time
Equipment
Water Level
—*Initials*

MYRTL MW-12 TD 35.00' 1"=5.00' 1:60.00 960321 1502 Sheet 1 of 2

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-81C[illegible]

MW-12
Geologic Borehole and Well Completion Log



MW-12
Geologic Borehole and Well Completion Log *(continued)*

Geologic Borehole and Well Completion Log

722450

Date	08/09/95	ESTDATE	Establishing Company	ESCI	ESCCODE
Northing	0.00 ft.	NCOORD	Drilling Company	ALL	DRLCODE
Easting	0.00 ft.	ECOORD	Drill Rig Type	mob b-61	DRLEQP
Borehole Total Depth	15.00 ft.	DEPTH	Construction Method	HS	CMCCODE

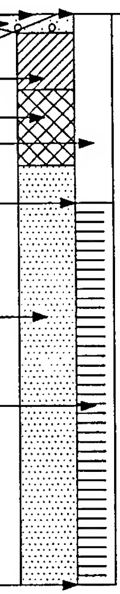
Air Force Installation	MYRTL	AFIID
Location Identification	**MW-13**	LOCID

Completion

Elevation feet MSL

0.00

Flush-mount casing
Portland cement concrete
0.00 toc
Cement/bentonite mixture
Bentonite
2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing
Top of screen
#10-#20 silica sand
10'x2.00" I.D. PVC (Polyvinyl Chloride (PVC)) screen, slot size: 0.020"
Base of casing



Sampling

Instrument Reading Penetration	SBD / SED	SMCODE	REC% (100 / 50)
pid 0.00 PPM	1.00	SS	
pid 0.00 PPM	3.00	SS	
pid 0.00 PPM	5.00	SS	
pid 1.00 PPM	7.00	SS	
pid 0.00 PPM	9.00	SS	
pid 2.00 PPM	11.00	SS	
pid 0.00 PPM	13.00	SS	
	15.00		

Depth

feet

Ground Surface

5, 10, 15

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description: *SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials*	STRATORDER
SP		sand, topsoil, dk. brn., dry. –PFB	
SM		sand, silty, fine–medium, olive gray and orange mottling, damp to moist, no odor. –PFB	
ML		silt, fine sandy, clayey, gray moist. –PFB	
SP		sand, lose, medium, silty in upper part, lt. gray, moist, no odor, wet @ 8', tr. silt, becomes dk. gray below 10'. –PFB	
ML		silt, fine sandy, clayey, dk. gray. –PFB	

Remarks

Depth
Borehole Diameter
Drilling Problems
Weather
Time
Equipment
Water Level
–Initials

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

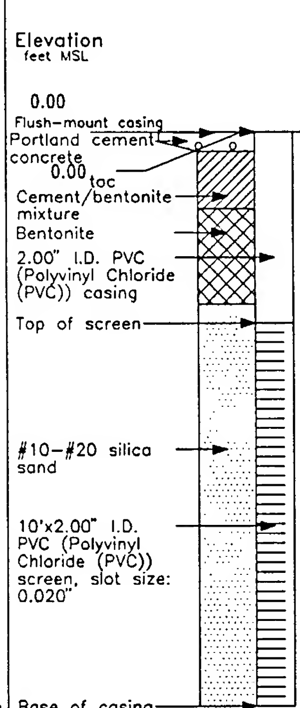
MW-13
Geologic Borehole and Well Completion Log

Geologic Borehole and Well Completion Log

722450

Date	08/10/95	ESTDATE	
Northing	0.00 ft.	NCOORD	
Easting	0.00 ft.	ECOORD	
Borehole Total Depth	15.00 ft.	DEPTH	
Establishing Company	ESCI	ESCCODE	
Drilling Company	ALL	DRLCODE	
Drill Rig Type	mob b-61	DRLEQP	
Construction Method	HS	CMCCODE	
Air Force Installation	MYRTL	AFIID	
Location Identification	**MW-14**	LOCID	

Completion



Sampling / Depth / Lithology

Instrument Reading Penetration	SBD–SED	SMCODE	Depth (feet)	USCS (ASTMCODE)	Description (SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –*Initials*)	STRATORDER
pid 0.00 PPM	1.00–3.00	SS	0–6	SM	sand, silty, fine–medium, brown, dry to damp, topsoil, orange and gray mottled below 1', silt content increases with depth, moist @ 5'. –PFB	
pid 0.00 PPM	3.00–5.00	SS				
pid 1.00 PPM	5.00–7.00	SS				
pid 0.00 PPM	7.00–9.00	SS	6–11.5	SP	sand, loose, medium, lt. gray, no odor. –PFB	
pid 0.00 PPM	9.00–11.00	SS				
pid 0.00 PPM	11.00–13.00	SS	11.5–13	SM	Sand, silty, fine–medium, shell fragments. –PFB	
pid 0.00 PPM	13.00–15.00	SS	13–15	ML	Silt, fine sandy, dk. gray, shell layer in silt matrix @ 13.8'. –PFB	

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather; Time, Equipment, Water Level –Initials

MYRTL MW-14 TD 15.00' 1"=5.00' 1:60.00 960321 1517 Sheet 1 of

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-14
Geologic Borehole and Well Completion Log

Geologic Borehole and Well Completion Log

722450

Date	08/10/95	ESTDATE	
Northing	0.00 ft.	NCOORD	
Easting	0.00 ft.	ECOORD	
Borehole Total Depth	37.50 ft.	DEPTH	
Establishing Company	ESCI	ESCCODE	
Drilling Company	ALL	DRLCODE	
Drill Rig Type	mob b-61	DRLEQP	
Construction Method	HS	CMCCODE	
Air Force Installation	MYRTL	AFIID	
Location Identification	**MW-15**	LOCID	

Completion

Elevation feet MSL

0.00 Flush-mount casing

Portland cement concrete

0.00 toc

Cement/bentonite mixture

2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

Sampling

Instrument Reading Penetration — SBD, SMCODE, SED — REC% (50, 100)

SBD	SMCODE	SED
3.00	SS	5.00
9.00	SS	11.00
13.00	SS	15.00
21.00	SS	23.00

Depth

feet — Ground Surface — 5, 10, 15, 20, 25

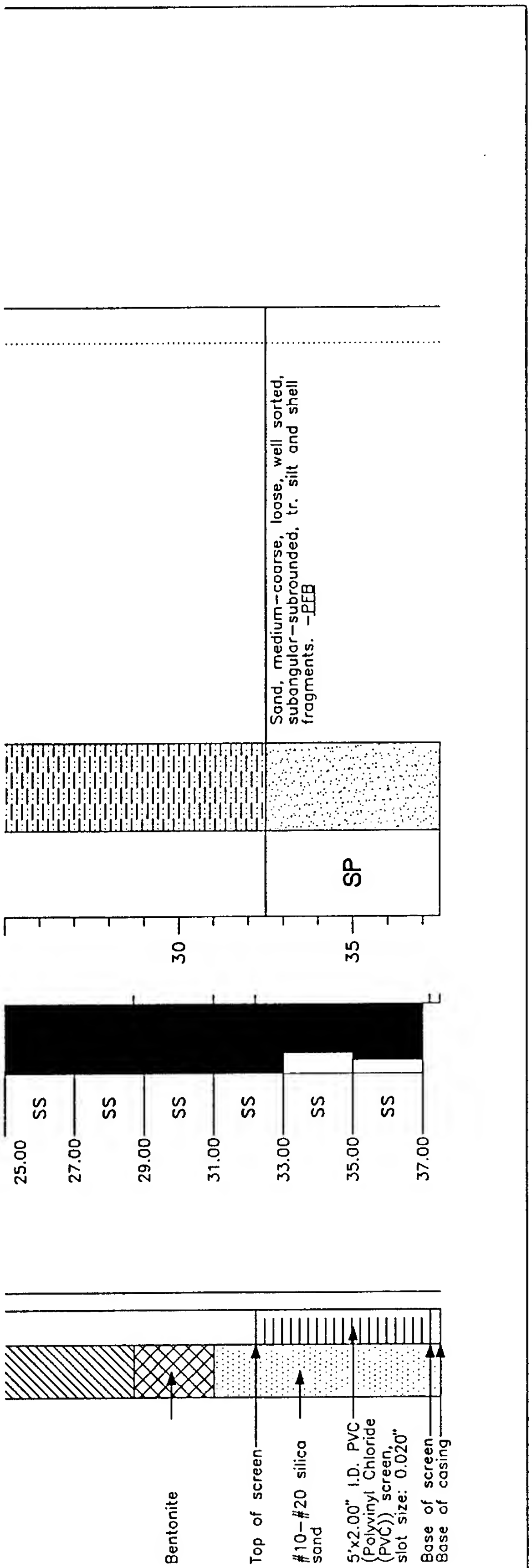
Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description: *SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials*	STRATORDER
SP		Sand, tr. silt, topsoil in upper foot, grades to lt. gray color. –PFB	
ML		Silt, sandy, clayey, olive gray and orsnge mottled, moist, no odor. –PFB	
SP		Sand, medium, loose, gray, wet, no odor. –PFB	
SM		Sand,silty, fine–medium, dk. gray, no odor, silt content increases with depth. –PFB	
ML		Silt, v. fine sandy, clayey, dk. gray, shell fragments, contact with overlaying sand estimated, shell fragments becoming more numerous. –PFB	

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather — Time, Equipment, Water Level –Initials

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831–8100



MYRTL MW-15 TD 37.50' 1"=5.00' 1:60.00 960321 1525 Sheet 2 of

MW-15
Geologic Borehole and Well Completion Log *(continued)*

Geologic Borehole and Well Completion Log

722450

Date	08/10/95 ESTDATE	Establishing Company	ESCI ESCCODE
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP
Borehole Total Depth	36.50 ft. DEPTH	Construction Method	HS CMCCODE

Air Force Installation MYRTL AFIID
Location Identification **MW-16** LOCID

Completion

Elevation feet MSL

0.00

Flush-mount casing
Portland cement concrete
0.00 toc

Cement/bentonite mixture

2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

Sampling

Instrument Reading Penetration | *SBD* *SMCODE* *SED* | 100 50 *REC%*

Instrument Reading	SBD–SED	SMCODE
pid 0.00 PPM	6.00–8.00	SS
	10.00–12.00	SS
	12.00–14.00	SS
pid 0.00 PPM	14.00–16.00	SS
pid 0.00 PPM	20.00–22.00	SS

Depth

feet

Ground Surface

5, 10, 15, 20, 25

Lithology

USCS Unified Soil Classification System ASTMCODE | Lithologic Symbols & Codes LITHCODE | Description *SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials* | STRATORDER

ASTMCODE	Description
SPSM	Sand, topsoil, brown, dry. –PFB
SM	Sand, silty, fine–medium, olive gray and orange mottled, damp, no odor. –PFB
SP	Sand, mediun, loose, tan to lt. gray, no odor, wet below 7', color dk. gray below 10'. –PFB
SM	Sand, silty, fine–medium, dk. gray, shell layer @ 13.2'. –PFB
ML	Silt, fine–v. fine sandy, clayey, dk. gray, no odor, shell fragments. –PFB

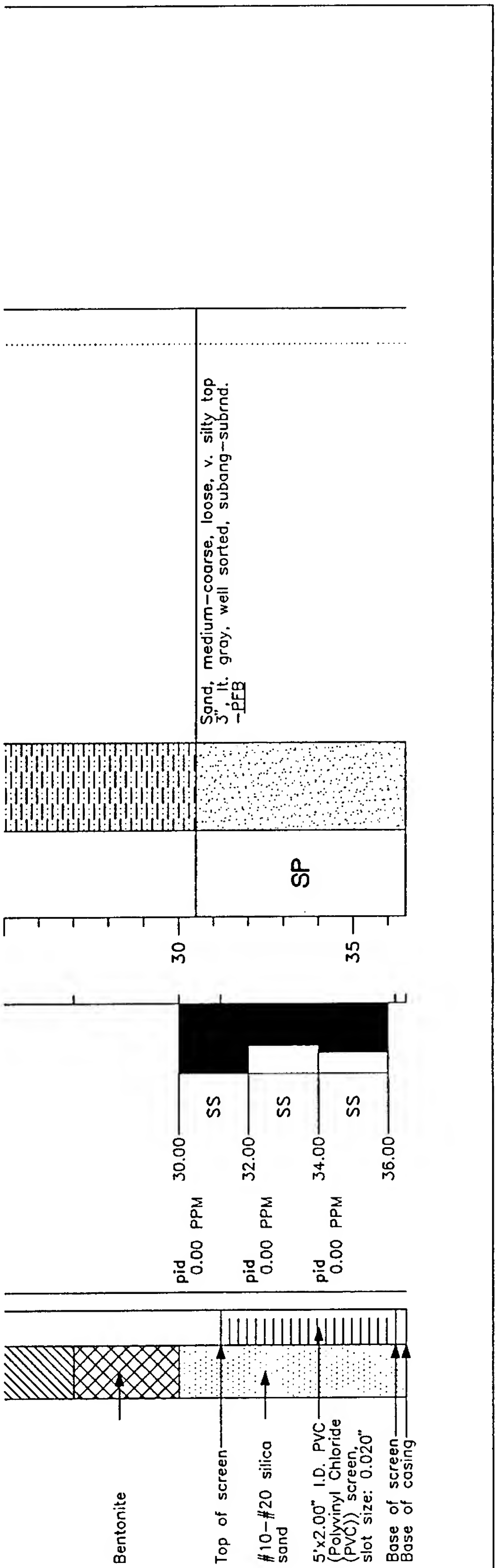
Remarks

Depth Borehole Diameter Drilling Problems Weather | *Time Equipment Water Level –Initials*

0.00' –PFB

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-16
Geologic Borehole and Well Completion Log



MYRTL MW-16 TD 36.50' 1"=5.00' 1:60.00 960321 1535 Sheet 2 of

MW-16
Geologic Borehole and Well Completion Log *(continued)*

Geologic Borehole and Well Completion Log

722450

Date	08/10/95 ESTDATE	Establishing Company	ESCI ESCCODE	Air Force Installation	MYRTL AFIID
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE	Location Identification	**MW-17** LOCID
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP		
Borehole Total Depth	15.00 ft. DEPTH	Construction Method	HS CMCCODE		

Completion

Elevation feet MSL

0.00

Flush-mount casing

Portland cement concrete

0.00 toc

Cement/bentonite mixture

Bentonite

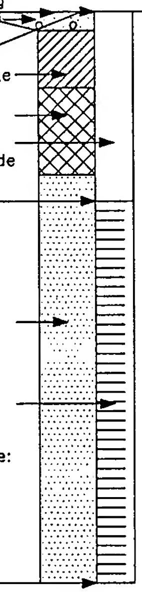
2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

Top of screen

#10–#20 silica sand

10'x2.00" I.D. PVC (Polyvinyl Chloride (PVC)) screen, slot size: 0.020"

Base of casing



Sampling

Instrument Reading Penetration — *SBD* — *SMCODE* — *SED* — 100 50 *REC%*

Instrument Reading	SBD / SED	SMCODE
	1.00 – 5.00	
	6.00 – 8.00	
pld 0.00 PPM	10.00 – 12.00	SS
pld 0.00 PPM	12.00 – 14.00	SS

Depth

feet

Ground Surface

5, 10, 15

Lithology

USCS (Unified Soil Classification System) ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description (*SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials*)	STRATORDER
SPSM		Sand, topsoil, brown, dry. –PFB	
SP		Sand, silty, fine–medium, olive gray & orange mottled, damp, no odor. –PFB	
SP		Sand, medium, loose, tan to lt. gray no odor, wet below 7'. –PFB	
SM		Sand, silty, fine–medium, dk. gray no odor, shell layer @ 13.2'. –PFB	

Remarks

Depth Borehole Diameter Drilling Problems Weather — *Time Equipment Water Level –Initials*

0.00' p.cldy, warm–hot –PFB

MYRTL MW–17 TD 15.00' 1"=5.00' 1:60.00 960321 1541 Sheet 1 of 1

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831–8100

MW–17
Geologic Borehole and Well Completion Log

Geologic Borehole and Well Completion Log

722450

Date	08/11/95 ESTDATE	Establishing Company	ESCI ESCCODE
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP
Borehole Total Depth	35.00 ft. DEPTH	Construction Method	HS CMCCODE

Air Force Installation — MYRTL — AFIID
Location Identification — **MW-18** — LOCID

Completion

Elevation feet MSL

0.00 Flush-mount casing
Portland cement concrete
0.00 toc
Cement/bentonite mixture
2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing

Sampling

Instrument Reading Penetration — SBD / SMCODE / SED — 100 50 REC%

Instrument Reading	SBD / SED	SMCODE
pid 0.00 PPM	5.00	SS
pid 0.00 PPM	7.00	SS
pid 0.00 PPM	9.00	SS
	11.00	
pid 0.00 PPM	20.00	SS
	22.00	

Depth feet — Ground Surface — 5, 10, 15, 20, 25

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. -Initials	STRATORDER
NACM		Asphalt -PFB	
NACM		Sand, topsoil, brown, dry. -PFB	
SM		Sand, silty, fine-medium, olive gray & orange mottled, damp to moist, no odor. -PFB	
SP		Sand, medium, lt. gray, well sorted, moist to wet, no odor. -PFB	
SM		Sand, silty, fine-medium, dk. gray, wet, no odor. -PFB	
ML		Silt, fine-v. fine sandy, dk. gray, no odor, shell fragments, contact with overlaying sand approximate. -PFB	

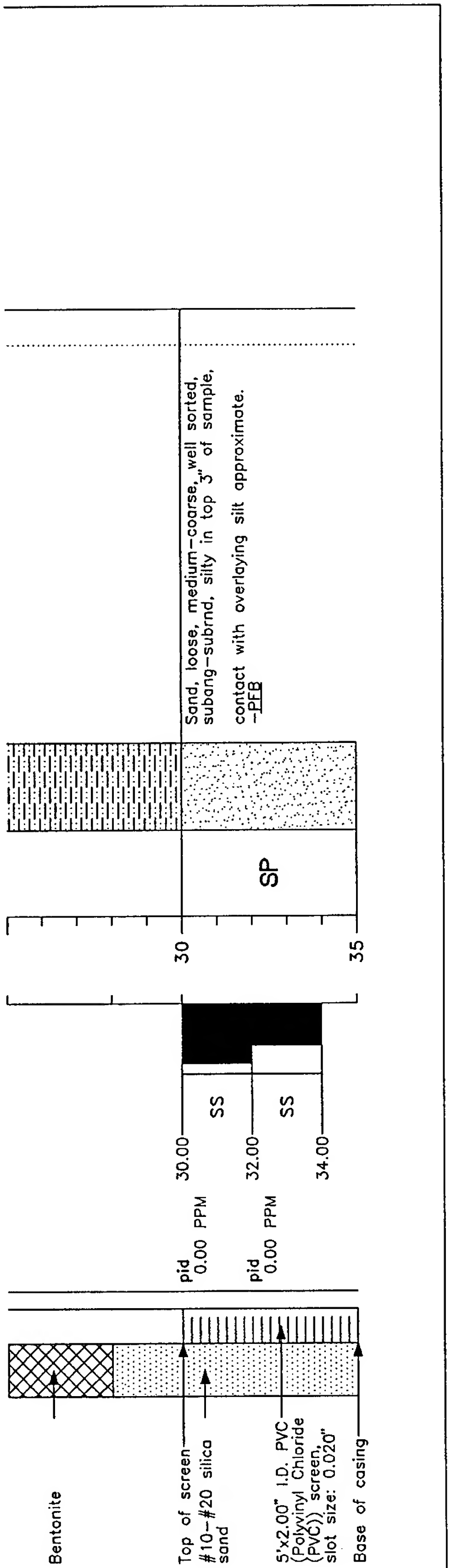
Remarks

Depth, Borehole Diameter, Drilling Problems, Weather — Time, Equipment, Water Level -Initials

MYRTL MW-18 TD 35.00' 1"=5.00' 1:60.00 960321 1551 Sheet 1 of

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-18
Geologic Borehole and Well Completion Log



MYRTL MW-18 TD 35.00' 1"=5.00' 1:60.00 960321 1551 Sheet 2 of 2

MW-18

Geologic Borehole and Well Completion Log *(continued)*

Geologic Borehole and Well Completion Log

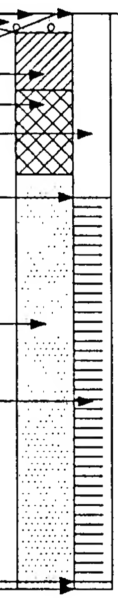
722450

Date	08/11/95 ESTDATE	Establishing Company	ESCI ESCCODE
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP
Borehole Total Depth	15.00 ft. DEPTH	Construction Method	HS CMCCODE

Air Force Installation MYRTL AFIID
Location Identification **MW-19** LOCID

Completion

Elevation feet MSL



0.00 Flush-mount casing
Portland cement concrete
0.00 toc
Cement/bentonite mixture
Bentonite
2.00" I.D. PVC (Polyvinyl Chloride (PVC)) casing
Top of screen
#10–#20 silica sand
10'x2.00" I.D. PVC (Polyvinyl Chloride (PVC)) screen, slot size: 0.020"
Base of screen
Base of casing

Sampling

Instrument Reading Penetration — SBD / SMCODE / SED — REC% (100, 50)

Instrument Reading	SBD	SMCODE	SED	REC%
pid 0.00 PPM	5.00	SS	7.00	
pid 0.00 PPM	9.00	SS	11.00	

Depth

feet
Ground Surface
5
10
15

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials	STRATORDER
NACM		asphalt –PFB	
NACM		Sand, topsoil, brown. –PFB	
SM		Sand, silty, fine–medium, olice gray & orange mottled, damp to moist, no odor. –PFB	
SP		Sand, medium, lt. gray, well sorted, damp to wet, no odor. –PFB	
SM		Sand, silty, fine–medium, dk. gray, wet, no odor. –PFB	

Remarks

Depth
Borehole Diameter
Drilling Problems
Weather

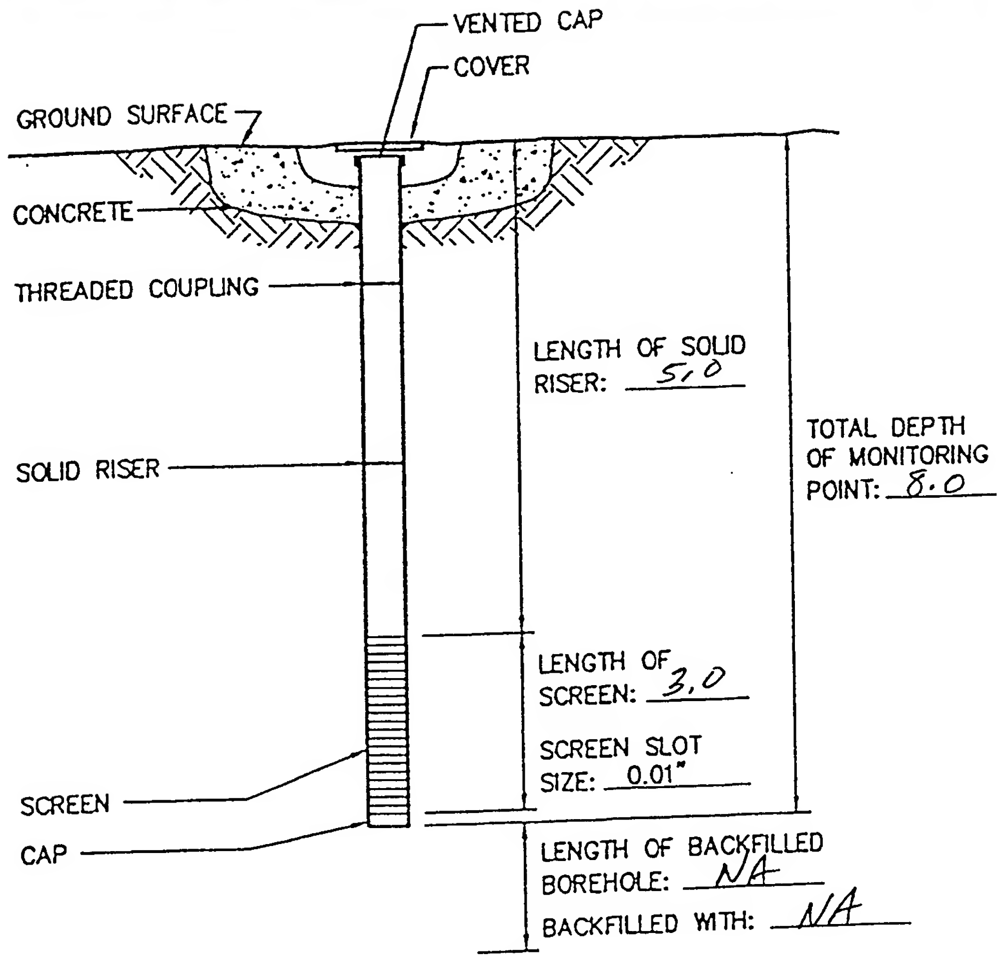
Time
Equipment
Water Level
–Initials

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

MW-19
Geologic Borehole and Well Completion Log

MONITORING POINT INSTALLATION RECORD

JOB NAME: MYRTLE BEACH - AIR FORCE BASE
MONITORING POINT NUMBER: SV-01
JOB NUMBER: 725522
INSTALLATION DATE: 1/18/95
LOCATION: MOGAS
DATUM ELEVATION: 25.31 ft msl
GROUND SURFACE ELEVATION: 24.98 ft msl
DATUM FOR WATER LEVEL MEASUREMENT: 25.31 ft msl
SCREEN DIAMETER & MATERIAL: 3/4" PVC
SLOT SIZE: 0.010"
RISER DIAMETER & MATERIAL: 3/4" PVC
BOREHOLE DIAMETER: 1 1/2"
CONE PENETROMETER CONTRACTOR: USACOE
ES REPRESENTATIVE: R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 8.0 FEET BELOW DATUM.

GROUND SURFACE 8.0 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

SV-01

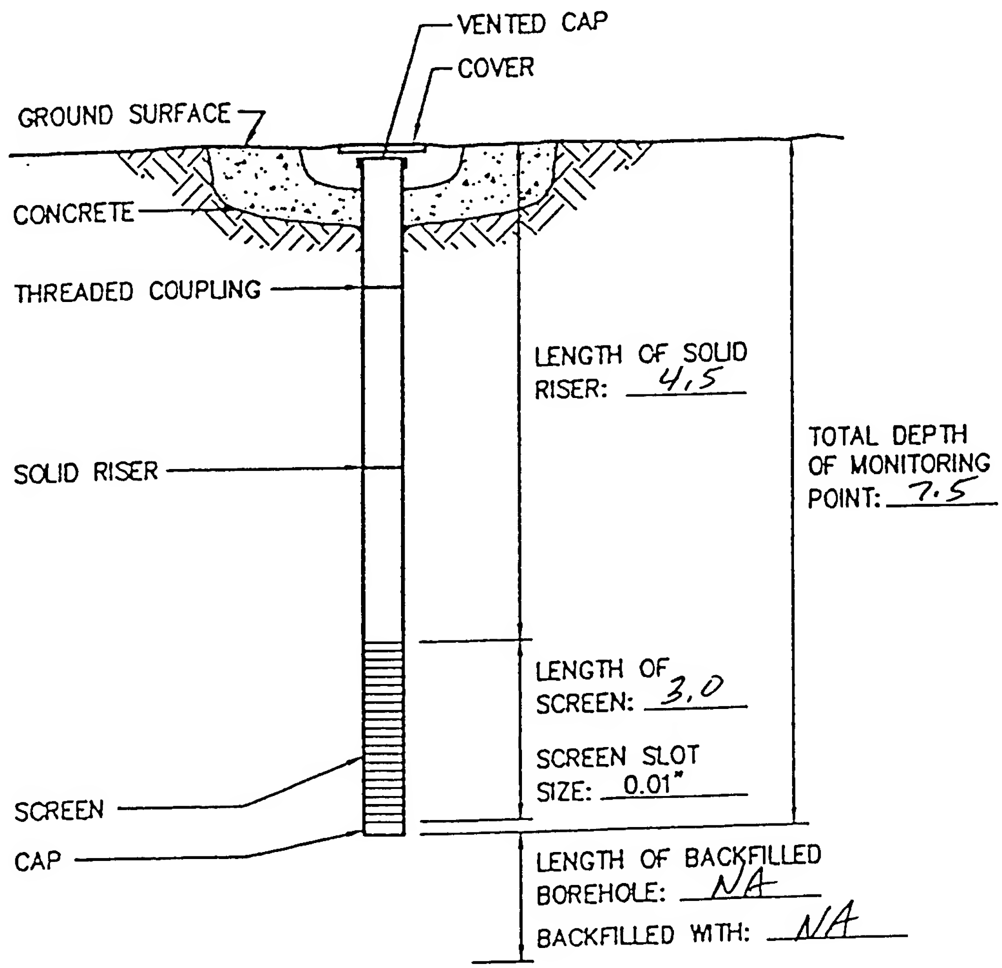
MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER SV-02
JOB NUMBER 725522 INSTALLATION DATE 1/18/95 LOCATION MOGAS
DATUM ELEVATION 25.56 ft msl GROUND SURFACE ELEVATION 25.16 ft msl
DATUM FOR WATER LEVEL MEASUREMENT 25.56 ft msl
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"
CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.
TOTAL MONITORING POINT DEPTH 7.5 FEET BELOW DATUM.
GROUND SURFACE 7.5 FEET

DRAFT
MONITORING POINT INSTALLATION RECORD
SV-02
MOGAS Site
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH - AIR FORCE BASE MONITORING POINT NUMBER SV-03

JOB NUMBER 725522 INSTALLATION DATE 1/18/95 LOCATION MOGAS

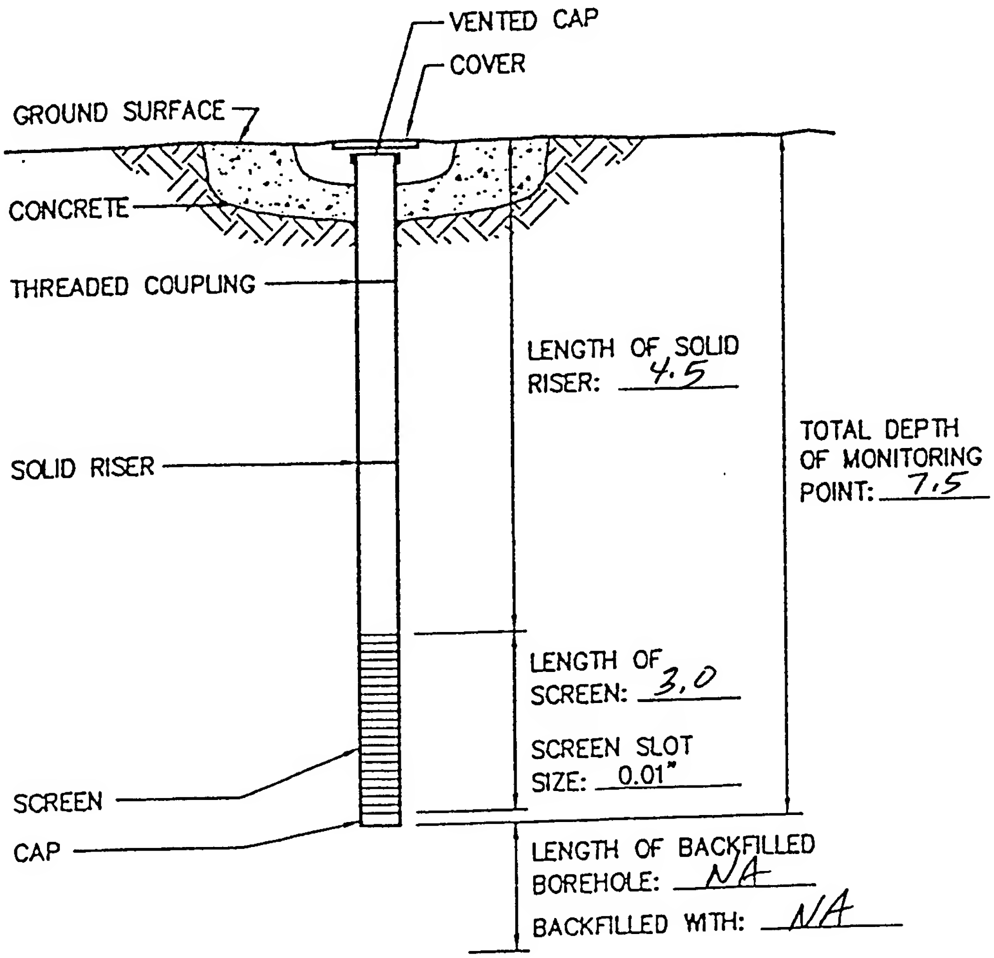
DATUM ELEVATION 25.75 ft msl GROUND SURFACE ELEVATION 25.37 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 25.75 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET
BELOW DATUM.

TOTAL MONITORING POINT DEPTH 7.5 FEET
BELOW DATUM.

GROUND SURFACE 7.5 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

SV-03

MOGAS Site

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER SV-04

JOB NUMBER 725522 INSTALLATION DATE 1/18/95 LOCATION MOGAS

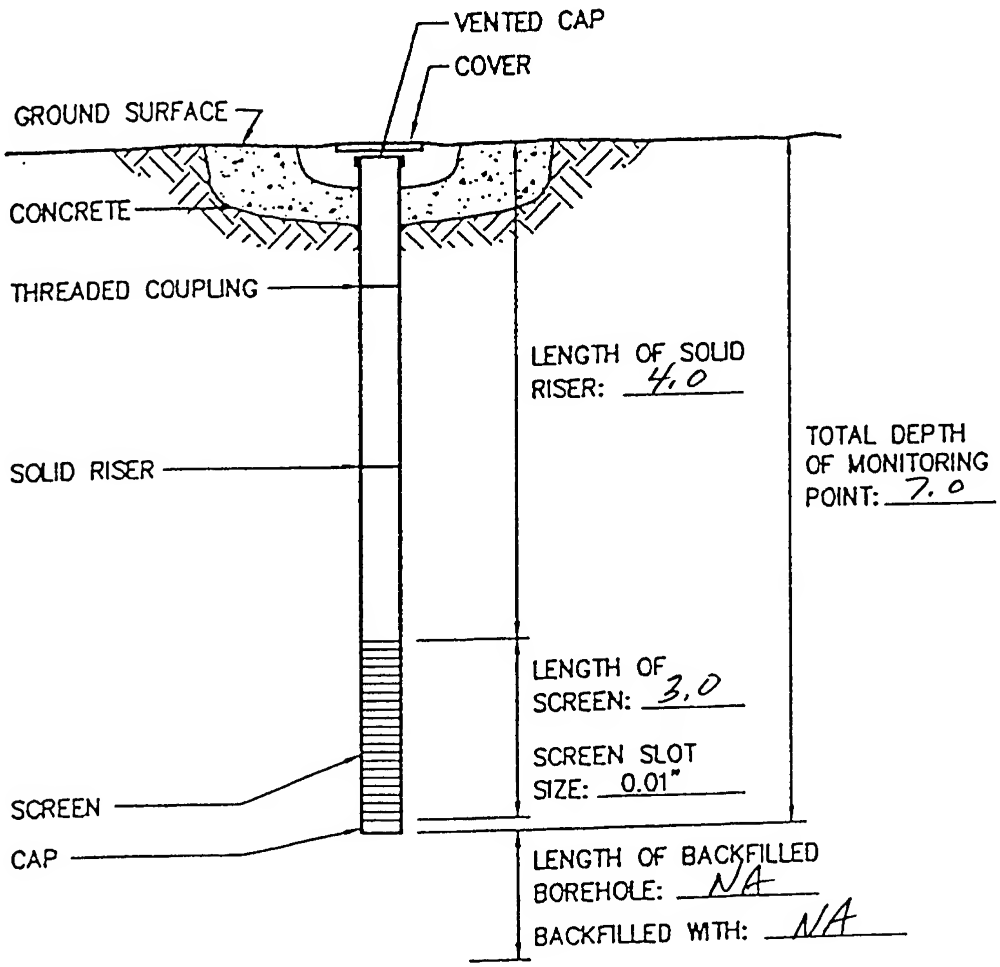
DATUM ELEVATION 25.92 ft msl GROUND SURFACE ELEVATION 25.57 ft msl

DATUM FOR WATER LEVEL MEASUREMENT 25.92 ft msl

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 1 1/2"

CONE PENETROMETER CONTRACTOR USACOE ES REPRESENTATIVE R. Henry



(NOT TO SCALE)

STABILIZED WATER LEVEL NM FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 7.0 FEET BELOW DATUM.

GROUND SURFACE 7.0 FEET

DRAFT

MONITORING POINT INSTALLATION RECORD

SV-04

MOGAS Site

Myrtle Beach Air Force Base

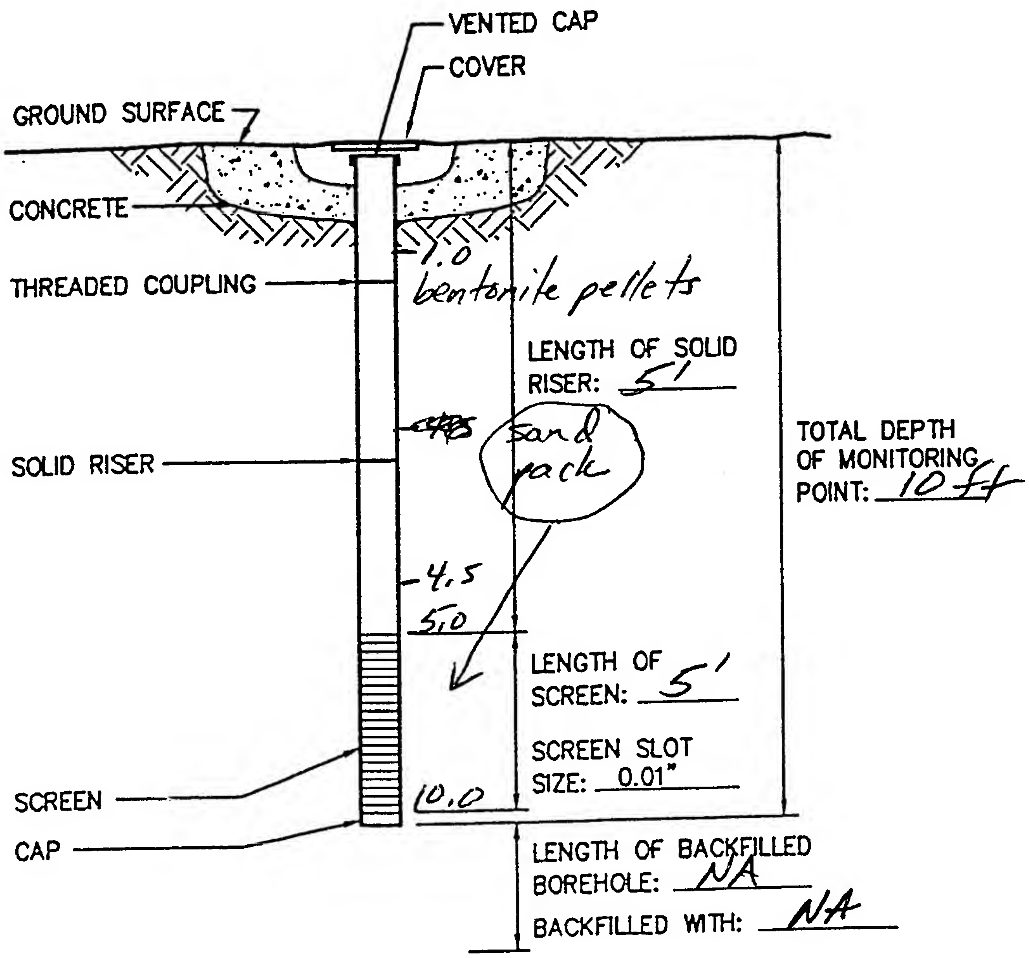
South Carolina

PARSONS ENGINEERING SCIENCE, INC

Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE
MONITORING POINT NUMBER SV-05
JOB NUMBER 725522
INSTALLATION DATE 8/11/95
LOCATION MOGAS
DATUM ELEVATION ______
GROUND SURFACE ELEVATION ______
DATUM FOR WATER LEVEL MEASUREMENT TOC
SCREEN DIAMETER & MATERIAL 3/4" PVC
SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC
BOREHOLE DIAMETER 8"
~~CONE PENETROMETER~~ CONTRACTOR ______
ES REPRESENTATIVE PFB



(NOT TO SCALE)

STABILIZED WATER LEVEL NA FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

GROUND SURFACE NA FEET

MOGAS
MONITORING POINT INSTALLATION RECORD
SV-05

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER SV-06

JOB NUMBER 725522 INSTALLATION DATE 8/11/95 LOCATION MOGAS

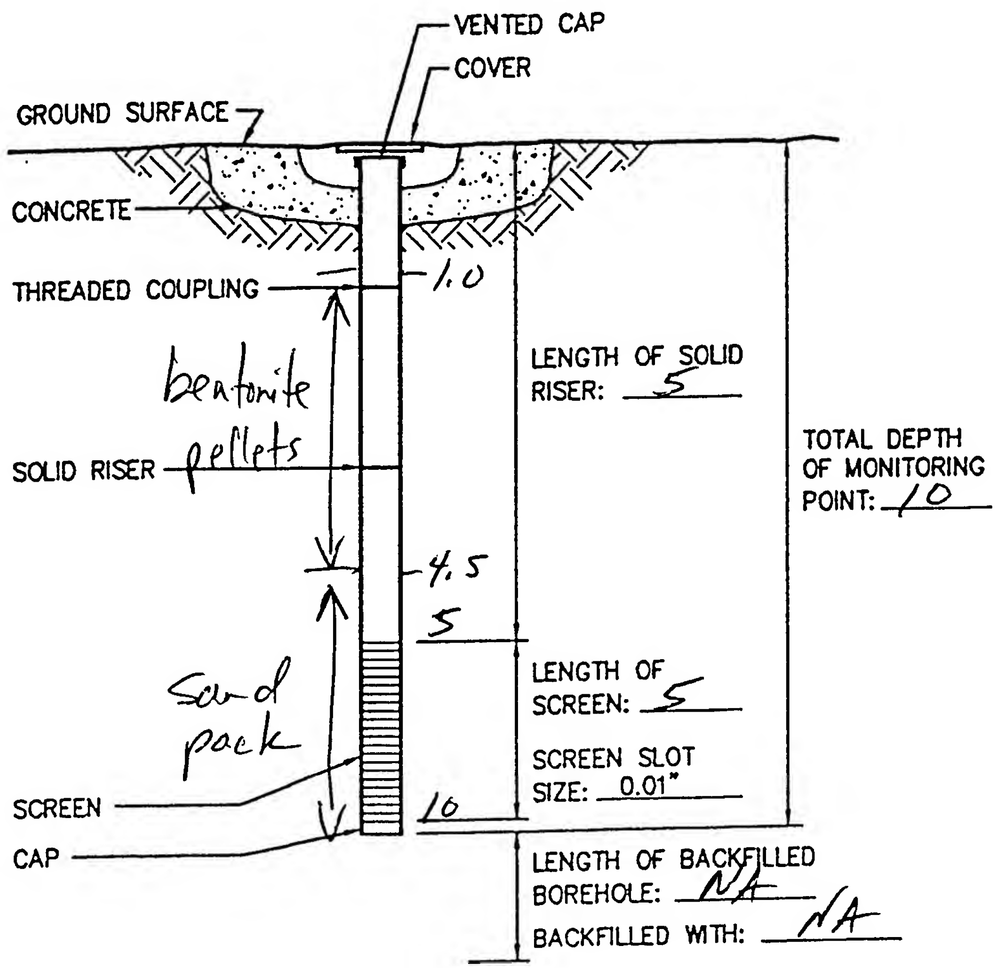
DATUM ELEVATION ______ GROUND SURFACE ELEVATION ______

DATUM FOR WATER LEVEL MEASUREMENT TOC

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 8"

~~CONE PENETROMETER~~ CONTRACTOR Alliance ES REPRESENTATIVE PFB



(NOT TO SCALE)

STABILIZED WATER LEVEL NA FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

GROUND SURFACE NA FEET

MOGAS

MONITORING POINT INSTALLATION RECORD

SV-06

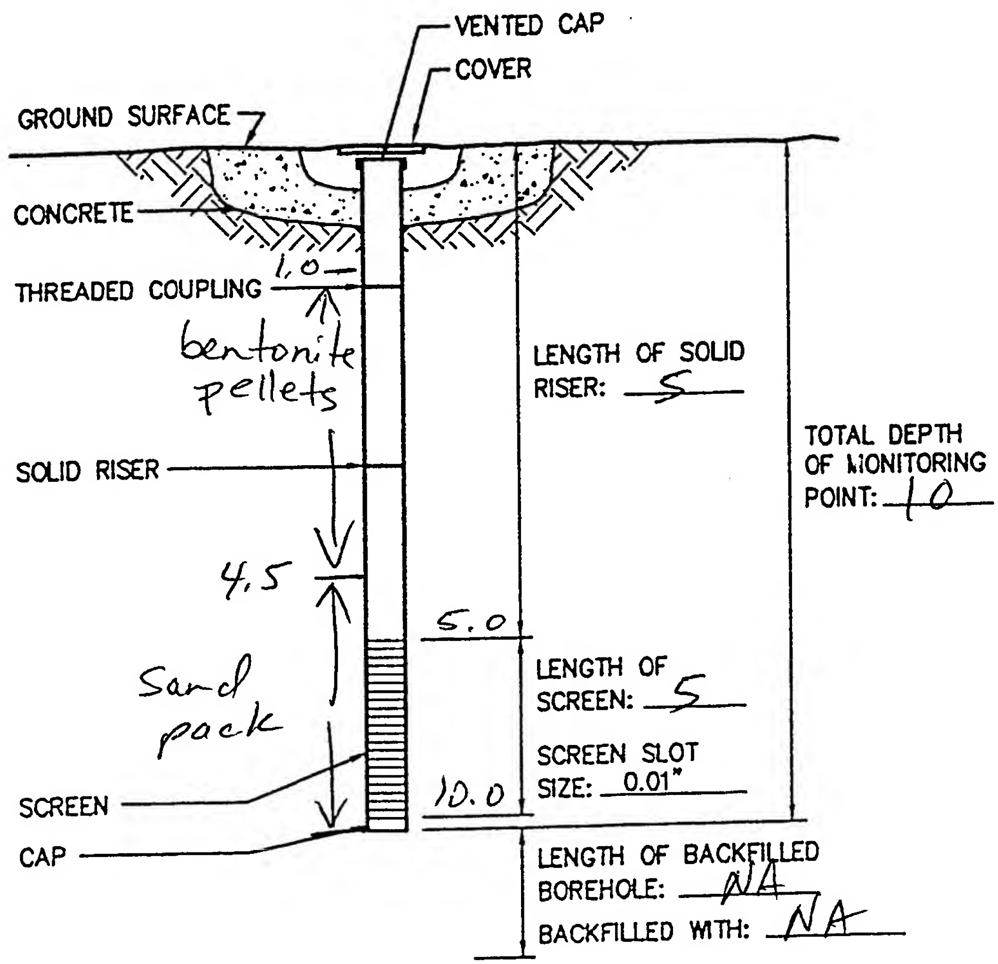
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC

Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER SV-07
JOB NUMBER 725522 INSTALLATION DATE 8/11/95 LOCATION MOGAS
DATUM ELEVATION ______ GROUND SURFACE ELEVATION ______
DATUM FOR WATER LEVEL MEASUREMENT TOC
SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"
RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 8"
~~CONE PENETROMETER~~ CONTRACTOR Alliance ES REPRESENTATIVE PFB



(NOT TO SCALE)

STABILIZED WATER LEVEL NA FEET BELOW DATUM.
TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.
GROUND SURFACE NA FEET

MOGAS
MONITORING POINT INSTALLATION RECORD
SV-07
Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME MYRTLE BEACH – AIR FORCE BASE MONITORING POINT NUMBER SV-08

JOB NUMBER 725522 INSTALLATION DATE 8/11/95 LOCATION MOGAS

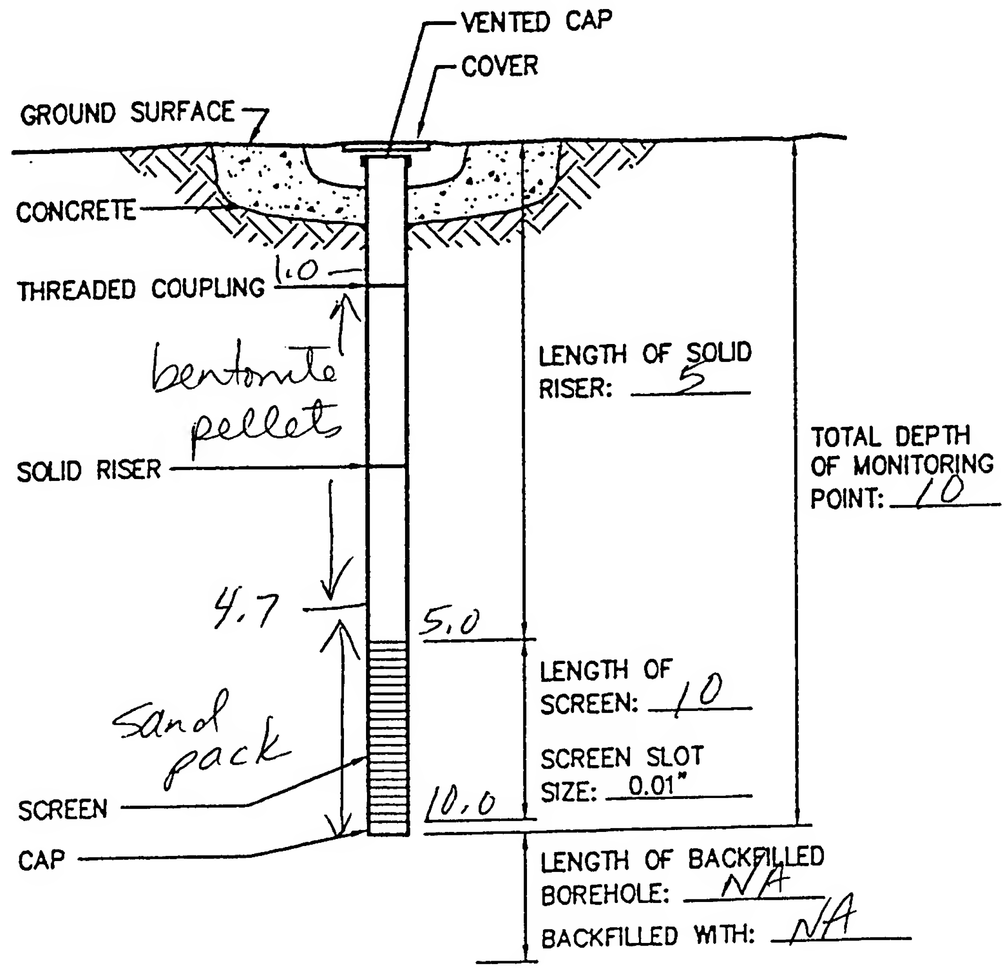
DATUM ELEVATION ______ GROUND SURFACE ELEVATION ______

DATUM FOR WATER LEVEL MEASUREMENT TOC

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.010"

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 8"

~~CONE PENETROMETER~~ CONTRACTOR Alliance ES REPRESENTATIVE PFB



(NOT TO SCALE)

STABILIZED WATER LEVEL NA FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH NA FEET BELOW DATUM.

GROUND SURFACE NA FEET

MOGAS

MONITORING POINT INSTALLATION RECORD

SV-08

Myrtle Beach Air Force Base
South Carolina

PARSONS ENGINEERING SCIENCE, INC

Denver, Colorado

Geologic Borehole and Well Completion Log

722450

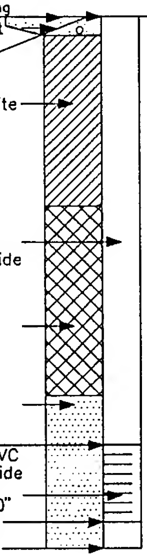
Date	08/09/95 ESTDATE	Establishing Company	ESCI ESCCODE
Northing	0.00 ft. NCOORD	Drilling Company	ALL DRLCODE
Easting	0.00 ft. ECOORD	Drill Rig Type	mob b-61 DRLEQP
Borehole Total Depth	14.00 ft. DEPTH	Construction Method	HS CMCCODE

Air Force Installation MYRTL AFIID
Location Identification **AS-1** LOCID

Completion

Elevation feet MSL

0.00



Sampling

Instrument Reading Penetration | SBD / SMCODE / SED | REC% (100, 50)

Instrument Reading	SBD–SED	SMCODE
	0.00	
pid 3.00 PPM	2.00–4.00	SS
pid 334.00 PPM	4.00–6.00	SS
pid 364.00 PPM	6.00–8.00	SS
pid 29.00 PPM	8.00–10.00	SS
pid 4.00 PPM	10.00–12.00	SS
pid 0.00 PPM	12.00–14.00	SS

Depth

feet

Ground Surface

5

10

Lithology

USCS Unified Soil Classification System ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. –Initials	STRATORDER
NACM		Sand, silty, topsoil w/roots, dk. brown –PFB	
SP		Sand, fine–medium, tr. silt, lt. brown gray, moist. –PFB	
SM		Sand, silt, dk. brown, moist, color change to gray @5', odor. –PFB	
SP		Sand, loose, medium, wet, strong odor, color changes to dk. gray @7.5'. –PFB	
SM		Sand, silty, fine–v. fine, dk. gray, wet, odor. –PFB	
ML		Silt, v. fine, sandy, clayey, dk. gray, shell fragments. –PFB	

Remarks

Depth / Borehole Diameter / Drilling Problems / Weather | Time / Equipment / Water Level / –Initials

0.00' p.cldy, warm. –PFB

MYRTL AS-1 TD 14.00' 1"=5.00' 1:60.00 960321 1241 Sheet 1 of 1

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

AS-1
Geologic Borehole and Well Completion Log

Geologic Borehole and Well Completion Log

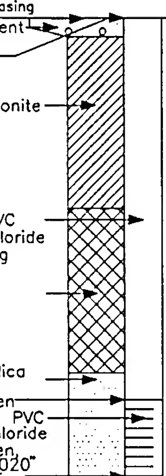
722450

Date	08/10/95	ESTDATE	
Northing	0.00 ft.	NCOORD	
Easting	0.00 ft.	ECOORD	
Borehole Total Depth	12.00 ft.	DEPTH	
Establishing Company	ESCI	ESCCODE	
Drilling Company	ALL	DRLCODE	
Drill Rig Type	mob b-61	DRLEQP	
Construction Method	HS	CMCCODE	
Air Force Installation	MYRTL	AFIID	
Location Identification	**AS-2**	LOCID	

Completion

Elevation feet MSL

0.00



Sampling

Instrument Reading Penetration	SBD / SED	SMCODE	REC% (100 / 50)
pid 6.00 PPM	3.00–5.00	SS	
pid 26.00 PPM	10.00–12.00	SS	

Depth

feet, Ground Surface (scale 0, 5, 10)

Lithology

USCS (Unified Soil Classification System) ASTMCODE	Lithologic Symbols & Codes LITHCODE	Description: SOIL/ROCK TYPE, modifiers/grain size, sorting, color, cement/lithification, moisture content, porosity, permeability/fracturing. *-Initials*	STRATORDER
NACM		sand, topsoil, dk. brown. -PFB	
SM		Sand, Silty, fine-medium, olive gray and orange mottled, damp. -PFB	
SP		Sand, loose, medium, gray, wet, odor, contact with overlaying sand approximate. -PFB	
SM		Sand, silty, fine-medium, dk. gray. -PFB	

Remarks

Depth, Borehole Diameter, Drilling Problems, Weather; Time, Equipment, Water Level -Initials

0.00' rainy. -PFB

AS-2
Geologic Borehole and Well Completion Log

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado (303) 831-8100

DERIVATION OF pe EQUATION

For some applications it is customary to report redox potential readings relative to the normal hydrogen electrode (NHE). To convert redox potential reading taken with a field meter and electrode the following equation is used:

$$E_H = E_o + C \qquad \text{Equation 1}$$

where;

E_H = oxidation reduction potential of the sample relative to the NHE in millivolts (mV)

E_o = potential developed by the field platinum redox electrode in mV

C = potential developed by the reference electrode portion relative to the NHE in mV

For the Orion Platinum Redox Electrode (model 96- or 97-78-00) with Orion filling solution 900001, C = 241 mV at 25°C. The constant C varies slightly with changing temperature; therefore, if the temperature of the electrode itself is below 10°C or above 30°C, C will correspond with the manufacturer's instructions.

Equation 23 from page 436 of Stumm and Morgan, 1981 is indeed the correct equation, and with a few substitutions the equation used to calculate pe in the Draft Corrective Action Plan is derived. Equation 23 from Stumm and Morgan is as follows:

$$pe = \frac{F * E_H}{2.3RT} \qquad \text{Equation 2}$$

On page 7, in the introduction of the Stumm and Morgan reference, the following is stated:

$RTF^{-1}(\ln 10) = 59.16$ mV at 25°C

therefore;

$2.3RT/F = 59.16$ mV

By replacing F/2.3RT, the inverse of 2.3RT/F, with the inverse of 59.16, Equation 2 is reduced to:

$$pe = E_H/59.16 \qquad \text{Equation 3}$$

And by substituting Equation 1 for E_H in Equation 3, the equation used in the Draft Corrective Action Plan appears.

$$pe = \frac{E_o + 241}{59.16} \qquad \text{Equation 4}$$

Equation 4 is the correct, probe specific, equation for calculating pe value from redox potential readings taken from an Orion Platinum Redox Electrode (model 96 or 97-78-00) with Orion filling solution 900001.

APPENDIX D

WATER LEVEL DATA, VERTICAL GRADIENT CALCULATIONS, AND AQUIFER TEST DATA

WATER-LEVEL MEASUREMENTS
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

Location	Datum Elevation	Depth to Water Jan-95 (ft TOC)	Water Elevation Jan-95 (ft MSL)	Depth to Water Aug-95 (ft TOC)	Water Elevation Aug-95 (ft MSL)	Depth to Water Oct-95 (ft TOC)	Water Elevation Oct-95 (ft MSL)
Groundwater Levels							
AS-01	19.62			5.14	14.48	4.44	15.18
AS-02	20.80			6.26	14.54	5.42	15.38
MOC-02	25.23	25.50	25.23	10.04	15.19	8.85	16.38
MOC-03	24.56	24.81	24.56	9.55	15.01	8.51	16.05
MOC-04	24.48	24.70	24.48	9.62	14.86	8.69	15.79
MOC-05	24.57	24.63	24.57	9.92	14.65	9.00	15.57
MOC-07	23.99	24.24	23.99	9.48	14.51	8.55	15.44
MOC-08	24.18	24.59	24.18	8.84	15.34	7.34	16.84
MOC-10	24.74	24.89	24.74	10.20	14.54	8.99	17.40
MOC-11	24.17	24.43	24.17	9.05	15.12	7.98	15.18
MOC-12	23.11	23.28	23.11	8.23	14.88	7.29	15.13
MOC-13	21.91	22.02	21.91	7.87	14.04	6.80	14.62
MOC-19	22.10	22.20	22.10	8.24	13.86	7.00	15.30
MOC-20	23.03	23.16	23.03	8.75	14.28	7.92	16.03
MOC-21	21.93	22.07	21.93	7.39	14.54	6.51	14.01
MW-01	27.72	10.81	16.91	12.05	15.67	10.81	21.21
MW-02	27.60	12.09	15.51	12.89	14.71	11.89	15.71
MW-03	22.87	8.01	14.86	8.52	14.35	7.80	15.07
MW-04	23.79	9.09	14.70	9.56	14.23	8.87	14.92
MW-05	21.93	6.83	15.10	7.37	14.56	6.64	15.29
MW-06	24.42			9.55	14.87	8.37	16.05
MW-07	25.47			9.33	16.14	7.90	17.57
MW-08	23.09			8.13	14.96	6.00	17.09
MW-09	23.10			7.51	15.59	5.94	17.16
MW-10	23.83			7.39	16.44	5.73	18.10
MW-11	20.76			6.57	14.19	5.81	14.95
MW-12	21.98			9.09	12.89	5.89	16.09
MW-13	21.93			6.31	15.62	4.13	17.80
MW-14	21.94			7.87	14.07	7.17	14.77
MW-15	22.34			9.52	12.82	6.31	16.03
MW-16	21.54			8.51	13.03	5.37	16.17
MW-17	21.66			7.76	13.90	6.45	15.21
MW-18	21.28			8.20	13.08	5.09	16.19
MW-19	21.23			7.21	14.02	6.11	15.12
MW-111	25.43	4.98	20.45	7.59	17.84	5.21	20.22
MW-112	22.46	7.47	14.99	8.01	14.45	7.28	15.18
MW-113	22.96	7.88	15.08	8.43	14.53	7.62	15.34
VENT-01	24.60					9.03	15.57
VENT-02	24.18					8.43	15.75
Surface Water Levels							
SW-01	24.69					1.49	14.14
SW-02	24.87					2.31	14.43
SW-03	25.13					2.63	14.45
SW-04	25.36					2.4	15.08
SW-05						1.40	14.23
SW-06						2.22	14.52
SW-07						2.53	14.55
SW-08						2.3	15.18

APPENDIX C
VERTICAL GRADIENTS
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

		Groundwater Elevation		Screen Interval	Ground Surface Elevation	Top Of Casing Elevation	Screen Elevation	Mid-Point of Saturated Screen Interval
		August	October	(ft bgs)				
Shallow	MW11	14.19	14.95	4-15	20.95	20.76	16.95 / 5.95	10.45
Deep	MW12	12.89	16.09	30-35	22.22	21.98	-7.78 / -12.78	-10.28
Deep	MW16	13.03	16.17	31.2-36.2	21.69	21.54	-9.51 / -14.51	-12.01
Shallow	MW17	13.90	15.21	5-15	21.83	21.66	16.83 / 6.83	11.83
Deep	MW18	13.08	16.19	30-35	21.36	21.28	-8.64 / -13.64	-11.14
Shallow	MW19	14.02	15.12	5-15	21.31	21.23	16.31 / 6.31	11.31
Deep	MW15	12.82	16.03	32.3-38.3	22.52	22.34	-9.78 / -15.78	-12.78
Shallow	MW111	17.89	20.22	3.5-13.5	22.76	25.43	19.26 / 9.26	14.26

$$\text{Gradient} = \frac{\text{Water Level Difference}}{\text{Distance between mid-points of saturated screen intevals}}$$

Mid-Point of Saturated Screen Interval (Aug/Oct)

MW11	10.07/10.45
MW12	-10.28/-10.28
MW16	-12.01/-12.01
MW17	10.36/11.02
MW18	-11.14/-11.14
MW19	10.16/10.71
MW15	-12.78/-12.78
MW111	13.55/14.26

Vertical Gradient

		Aug	Oct
North of Ditch	MW11 MW12	0.064↓	0.055↑
South of Ditch	MW16 MW17	0.039↓	0.042↑
	MW18 MW19	0.044↓	0.049↑
Way North of Ditch	MW15 MW111	0.191↓	0.155↑

Myrtle Beach AFB
Slug Tests

Well No	Slug Test Type	Well T.D* (Ft)	Depth to SWL* (Ft)	Static height of Water in well (Ft)	Screen length (Ft)	Well diameter	Bore hole diameter
MW06	falling (r)	16.2'	9.51'	6.69	10'	2"	8"
(8/14/95)	rising (f)	"	9.51'	6.69	10'	2"	
MW07	falling	16.2	9.27'	6.93	10'	2"	
(8/14/95)	rising	"	"	6.93	10'	2"	
MW09	falling	15.84'	7.48"	8.36	10'	2"	
(8/14/95)	rising	15.84'	7.48"	8.36	10'	2"	
MW10	falling	17'	7.35'	9.65	10'	2"	
(8/14/95)	rising	17'	7.35	9.65	10'	2"	
MW11	falling	13.92'	6.48'	7.44	11'	2"	
(8/14/95)	rising	13.92'	6.48'	7.44	11'	2"	
MW13	falling	13.6'	6.25'	7.35	10'	2"	
(8/14/95)	rising	13.6'	6.25'	7.35	10	2"	
MW17	falling	14.55'	7.76'	6.79	10'	2"	
(8/15/95)	rising	14.55	7.76'	6.79	10'	2"	

* measured from T.O.C.

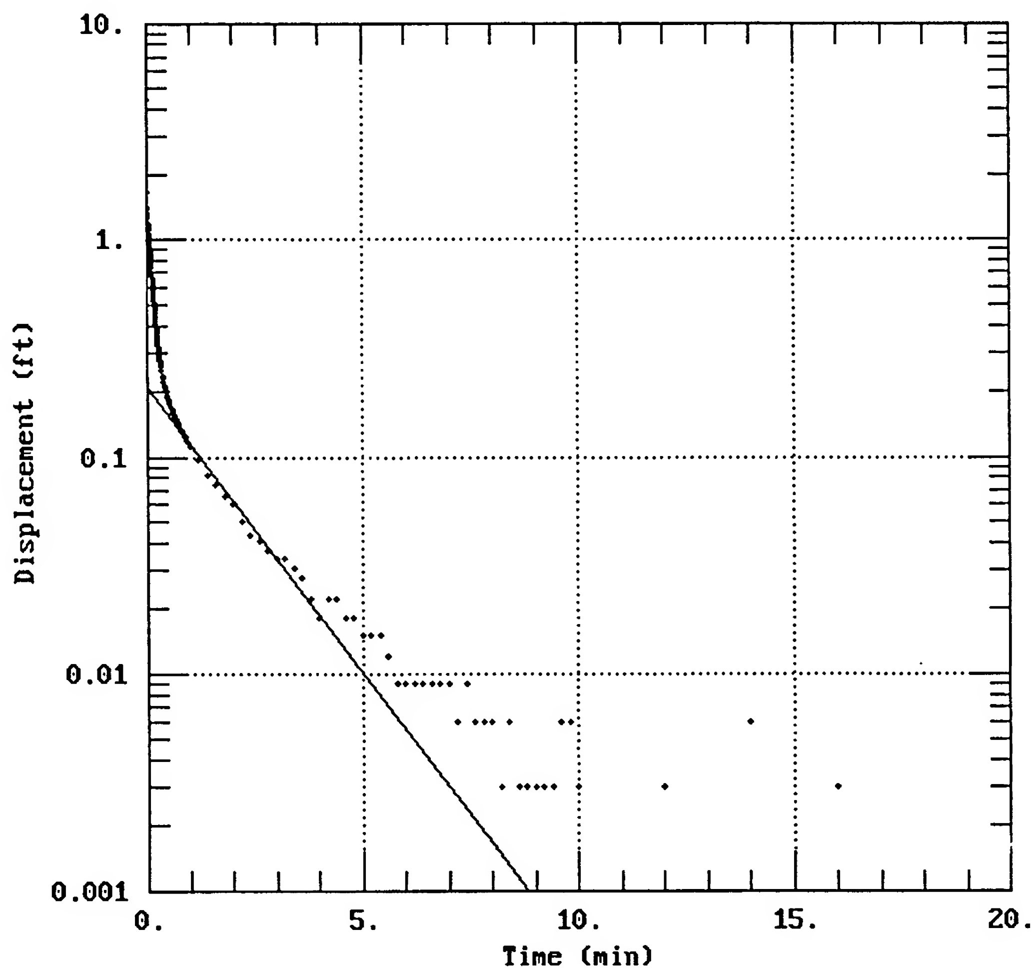
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: WELL MW06

PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW06



DATA SET:
FALLMW06.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 4.438 ft
r_c= 0.08333 ft
r_w= 0.34 ft
L = 6.69 ft
b = 6.69 ft
H = 6.69 ft

PARAMETER ESTIMATES:
K = 5.683 ft/day
y0 = 0.2087 ft

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V   R E S U L T S
                                 Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

4/18/96                                                              08:43:45

================================================================================
                                TEST DESCRIPTION

Data set........... FALLMW06.DAT
Output file........ FALLMW06.OUT
Data set title..... FALLING HEAD SLUG TEST MW06
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... WELL MW06
Test date.......... AUGUST 16, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 4.438
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.34
   Aquifer saturated thickness...... 6.69
   Well screen length............... 6.69
   Static height of water in well... 6.69
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1988
   Effective wellbore radius........ 0.34
   Log(Re/Rw)....................... 2.207
   Constants A, B and C............. 0.000 ,   0.000,   1.651
   No. of observations.............. 187

================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   K  =    5.6830E+000 +/-   1.4488E-001 ft/day
   y0 =    2.0872E-001 +/-   3.8786E-003 ft

ANALYSIS OF MODEL RESIDUALS

Residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 33
Number of estimated parameters.... 2
Degrees of freedom................ 31
Residual mean..................... 0.0006258
Residual standard deviation....... 0.003877
Residual variance................. 1.503E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.8	0.132	0.12863	0.0033696	1
0.8166	0.132	0.12734	0.0046551	1
0.8333	0.129	0.12606	0.0029354	1
0.85	0.126	0.1248	0.0012029	1
0.8666	0.126	0.12355	0.0024501	1
0.8833	0.123	0.12231	0.00069227	1
0.9	0.123	0.12108	0.0019219	1
0.9166	0.12	0.11987	0.00013199	1
0.9333	0.12	0.11866	0.0013371	1
0.95	0.116	0.11747	-0.0014698	1
0.9666	0.116	0.1163	-0.00029585	1
0.9833	0.113	0.11513	-0.0021266	1
1	0.113	0.11397	-0.00096915	1
1.2	0.097	0.10098	-0.003979	1
1.4	0.082	0.089469	-0.0074694	1
1.6	0.075	0.079272	-0.0042718	1
1.8	0.066	0.070236	-0.0042364	1
2	0.06	0.062231	-0.0022309	1
2.2	0.05	0.055138	-0.0051378	1
2.4	0.044	0.048853	-0.0048532	1
2.6	0.041	0.043285	-0.002285	1
2.8	0.037	0.038351	-0.0013514	1
3	0.034	0.03398	1.9912E-005	1
3.2	0.034	0.030107	0.0038929	1
3.4	0.031	0.026675	0.0043245	1
3.6	0.028	0.023635	0.004365	1
3.8	0.022	0.020941	0.0010589	1
4	0.018	0.018554	-0.00055424	1
4.2	0.022	0.016439	0.0055606	1
4.4	0.022	0.014566	0.0074343	1
4.6	0.018	0.012905	0.0050945	1
4.8	0.018	0.011435	0.0065655	1
5	0.015	0.010131	0.0048688	1

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	5.6830E+000 ft/day
y0 =	2.0872E-001 ft

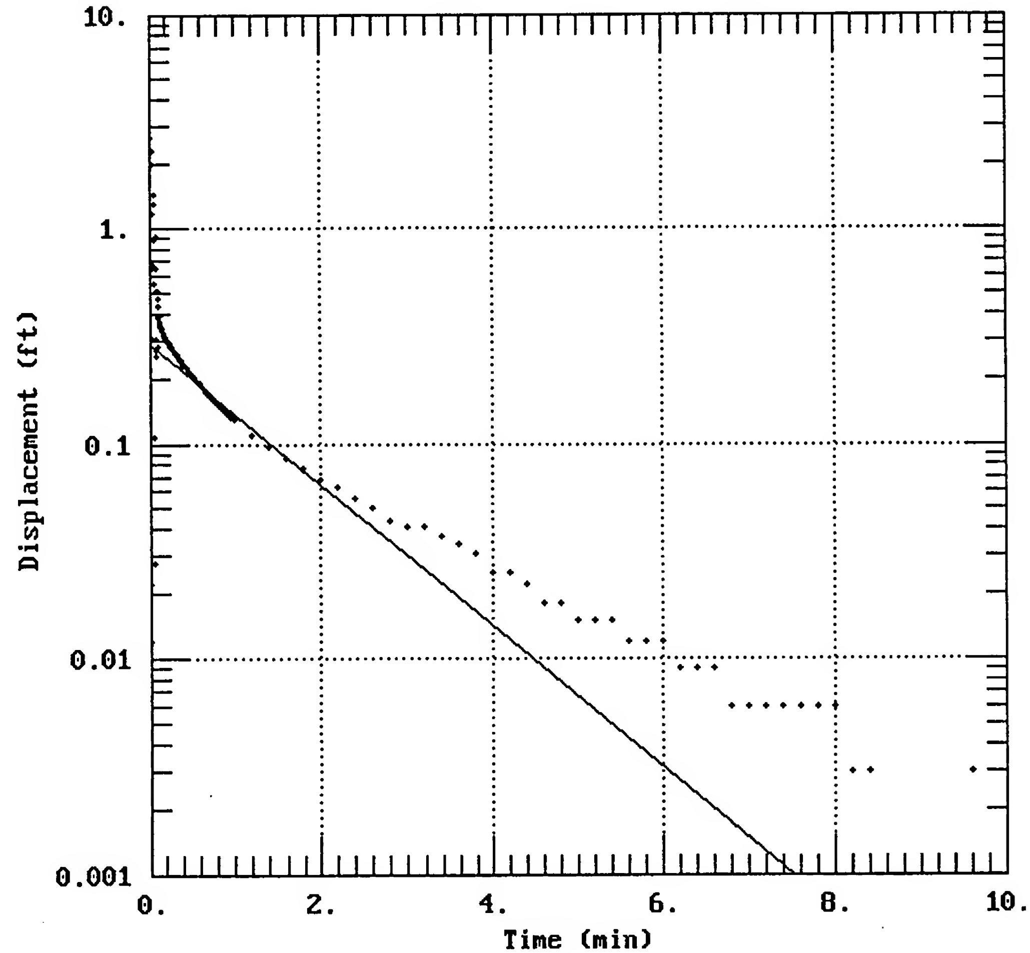
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW06

PROJECT: 725522.04000

RISING HEAD SLUG TEST MW06



DATA SET:
RISEMW06.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1. ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 6.69 ft
b = 6.69 ft
H = 6.69 ft

PARAMETER ESTIMATES:
K = 6.849 ft/day
y0 = 0.2841 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                               Version 2.01

                      Developed by Glenn M. Duffield
                  (c) 1988-1995  Geraghty & Miller, Inc.

04/18/96                                                                  08:46

================================================================================
                              TEST DESCRIPTION

Data set........... RISEMW06.DAT
Output file........ RISEMW06.OUT
Data set title..... RISING HEAD SLUG TEST MW06
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW06
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 6.69
   Well screen length............... 6.69
   Static height of water in well... 6.69
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.225
   Constants A, B and C............. 0.000 ,  0.000,  1.663
   No. of observations.............. 175

================================================================================
                              ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

              Estimate          Std. Error
   K  =    6.8489E+000 +/-   2.1234E-001 ft/day
   y0 =    2.8412E-001 +/-   5.3960E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

- Number of residuals.............. 41
- Number of estimated parameters.... 2
- Degrees of freedom............... 39
- Residual mean..................... 0.0005211
- Residual standard deviation....... 0.006114
- Residual variance................. 3.738E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.5	0.208	0.19526	0.012739	1
0.5166	0.202	0.19284	0.0091558	1
0.5333	0.199	0.19044	0.0085566	1
0.55	0.195	0.18807	0.0069275	1
0.5666	0.189	0.18575	0.0032549	1
0.5833	0.189	0.18343	0.0055673	1
0.6	0.186	0.18115	0.004851	1
0.6166	0.183	0.17891	0.0040927	1
0.6333	0.18	0.17668	0.00332	1
0.65	0.176	0.17448	0.0015195	1
0.6666	0.173	0.17232	0.00067877	1
0.6833	0.17	0.17018	-0.00017594	1
0.7	0.167	0.16806	-0.0010574	1
0.7166	0.164	0.16598	-0.0019776	1
0.7333	0.161	0.16391	-0.0029113	1
0.75	0.157	0.16187	-0.0048707	1
0.7666	0.157	0.15987	-0.0028675	1
0.7833	0.154	0.15788	-0.0038773	1
0.8	0.151	0.15591	-0.0049118	1
0.8166	0.148	0.15398	-0.0059824	1
0.8333	0.148	0.15207	-0.0040654	1
0.85	0.145	0.15017	-0.0051723	1
0.8666	0.142	0.14831	-0.0063139	1
0.8833	0.142	0.14647	-0.0044675	1
0.9	0.138	0.14464	-0.006644	1
0.9166	0.138	0.14285	-0.004854	1
0.9333	0.135	0.14108	-0.0060756	1
0.95	0.132	0.13932	-0.0073193	1
0.9666	0.132	0.1376	-0.0055952	1
0.9833	0.132	0.13588	-0.0038822	1
1	0.129	0.13419	-0.0051906	1
1.2	0.11	0.1155	-0.0054955	1
1.4	0.097	0.099405	-0.002405	1
1.6	0.085	0.085556	-0.00055612	1
1.8	0.078	0.073637	0.0043633	1
2	0.069	0.063378	0.0056222	1
2.2	0.063	0.054548	0.0084518	1
2.4	0.056	0.046949	0.0090514	1
2.6	0.05	0.040408	0.0095921	1
2.8	0.044	0.034778	0.0092216	1
3	0.041	0.029933	0.011067	1

===

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

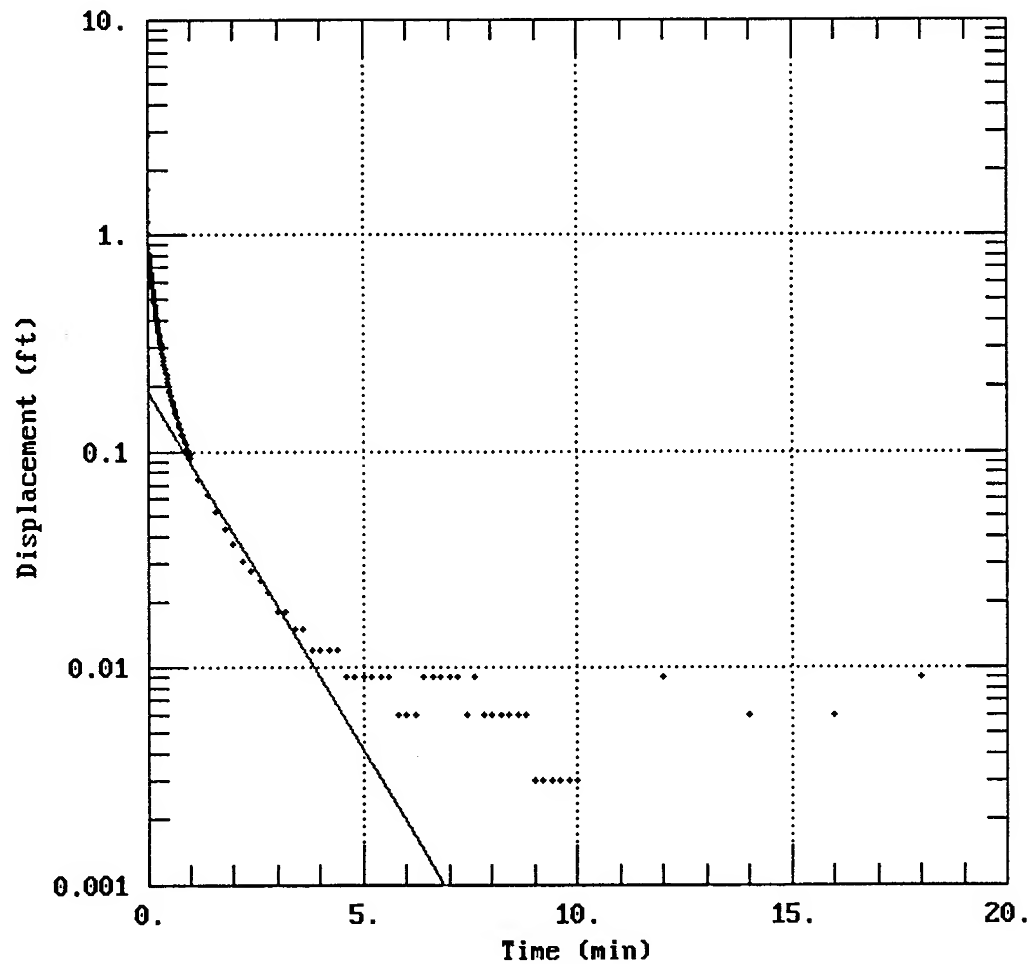
	Estimate
K =	6.8489E+000 ft/day
y0 =	2.8412E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

CLIENT: MYRTLE BEACH AFB | COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW07 | PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW07



DATA SET:
FALLMW07.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.919 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 6.93 ft
b = 6.93 ft
H = 6.93 ft

PARAMETER ESTIMATES:
K = 6.801 ft/day
y0 = 0.1872 ft

AQTESOLV

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 2.01

Developed by Glenn M. Duffield

04/18/96 08:4

===

TEST DESCRIPTION

```
Data set........... FALLMW07.DAT
Output file........ FALLMW07.OUT
Data set title..... FALLING HEAD SLUG TEST MW07
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW07
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 2.919
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 6.93
   Well screen length............... 6.93
   Static height of water in well... 6.93
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.255
   Constants A, B and C............. 0.000 ,  0.000,  1.685
   No. of observations.............. 202
```

===

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

===

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
K =	6.8011E+000	+/-	2.9073E-001	ft/day
y0 =	1.8723E-001	+/-	1.0141E-002	ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals............... 21
Number of estimated parameters.... 2
Degrees of freedom................ 19
Residual mean..................... 0.0009071
Residual standard deviation....... 0.003448
Residual variance................. 1.189E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.094	0.087454	0.0065461	1
1.2	0.075	0.075104	-0.00010352	1
1.4	0.063	0.064497	-0.0014973	1
1.6	0.053	0.055389	-0.0023888	1
1.8	0.044	0.047567	-0.0035667	1
2	0.037	0.040849	-0.0038492	1
2.2	0.031	0.03508	-0.0040804	1
2.4	0.028	0.030126	-0.0021263	1
2.6	0.025	0.025872	-0.00087181	1
2.8	0.022	0.022218	-0.00021815	1
3	0.018	0.01908	-0.0010805	1
3.2	0.018	0.016386	0.0016141	1
3.4	0.015	0.014072	0.00092817	1
3.6	0.015	0.012085	0.0029154	1
3.8	0.012	0.010378	0.001622	1
4	0.012	0.0089124	0.0030876	1
4.2	0.012	0.0076538	0.0043462	1
4.4	0.012	0.0065729	0.0054271	1
4.6	0.009	0.0056446	0.0033554	1
4.8	0.009	0.0048475	0.0041525	1
5	0.009	0.0041629	0.0048371	1

==

RESULTS FROM VISUAL CURVE MATCHING

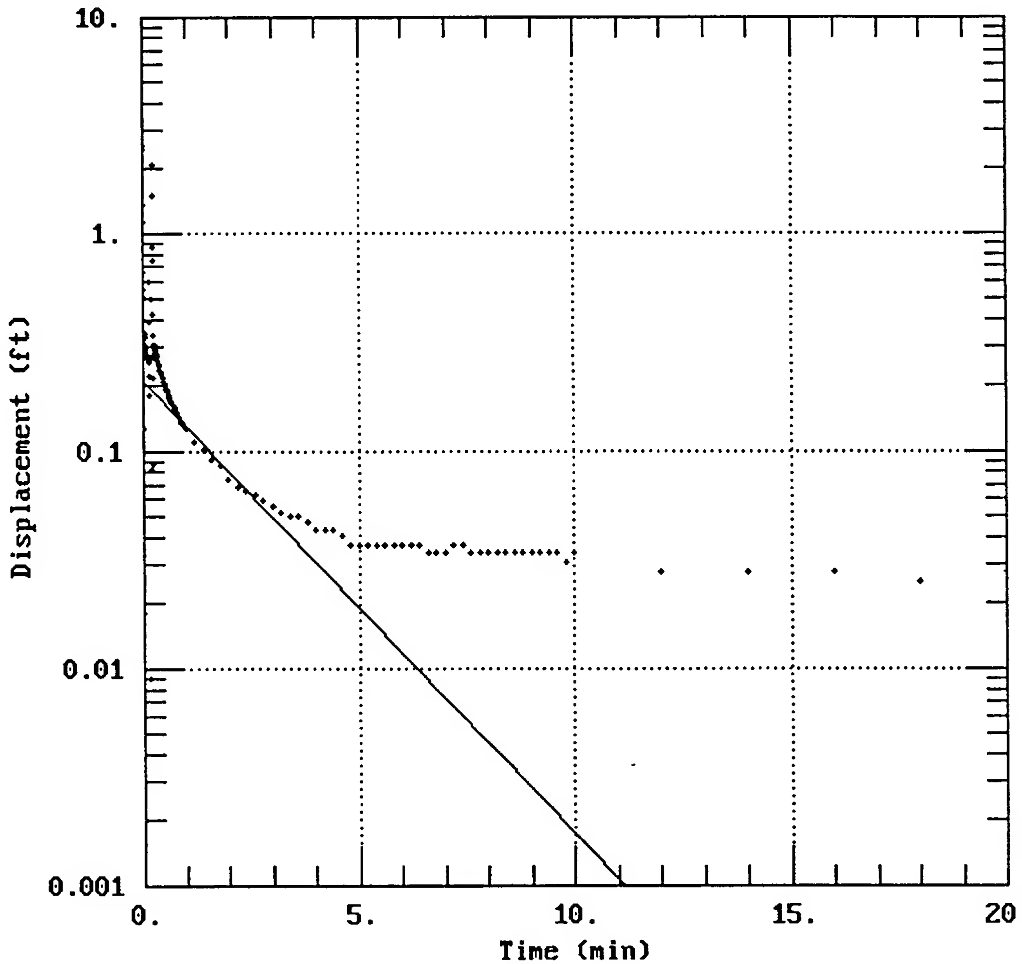
VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	6.8011E+000 ft/day
y0 =	1.8723E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

CLIENT: MYRTLE BEACH AFB	COMPANY: PARSONS ENGINEERING SCIENCE
LOCATION: MW07	PROJECT: 725522.04000

RISING HEAD SLUG TEST MW07



DATA SET:
RISEMW07.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.567 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 6.93 ft
b = 6.93 ft
H = 6.93 ft

PARAMETER ESTIMATES:
K = 4.279 ft/day
y0 = 0.2058 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S

Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

4/18/96 08:54:32

===

TEST DESCRIPTION

Data set........... RISEMW07.DAT
Output file........ RISEMW07.OUT
Data set title..... RISING HEAD SLUG TEST MW07
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW07
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 2.567
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 6.93
   Well screen length............... 6.93
   Static height of water in well... 6.93
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.255
   Constants A, B and C............. 0.000 , 0.000, 1.685
   No. of observations.............. 178

===

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

===

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
K =	4.2790E+000	+/-	1.2738E-001	ft/day
y0 =	2.0583E-001	+/-	3.4646E-003	ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals................ 23
Number of estimated parameters.... 2
Degrees of freedom................ 21
Residual mean..................... 0.000118
Residual standard deviation....... 0.003496
Residual variance................. 1.222E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.8	0.145	0.14032	0.0046834	1
0.8166	0.142	0.13921	0.0027945	1
0.8333	0.142	0.1381	0.0039034	1
0.85	0.138	0.137	0.0010036	1
0.8666	0.138	0.13591	0.0020884	1
0.8833	0.135	0.13483	0.00017111	1
0.9	0.135	0.13375	0.0012452	1
0.9166	0.132	0.1327	-0.00069564	1
0.9333	0.132	0.13164	0.00036145	1
0.95	0.129	0.13059	-0.0015899	1
0.9666	0.129	0.12956	-0.00055578	1
0.9833	0.126	0.12852	-0.0025237	1
1	0.126	0.1275	-0.0014999	1
1.2	0.11	0.11585	-0.0058538	1
1.4	0.101	0.10527	-0.0042715	1
1.6	0.091	0.095656	-0.0046558	1
1.8	0.085	0.086918	-0.0019184	1
2	0.075	0.078979	-0.0039791	1
2.2	0.069	0.071765	-0.002765	1
2.4	0.066	0.06521	0.00079013	1
2.6	0.063	0.059253	0.0037465	1
2.8	0.059	0.053841	0.0051588	1
3	0.056	0.048923	0.0070768	1

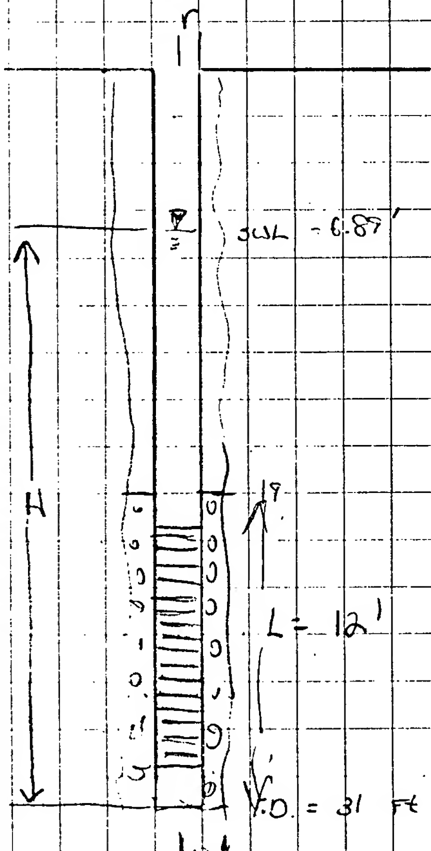
===

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 4.2790E+000 ft/day
y0 = 2.0583E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>



Horslev Method

$$K = \frac{r^2 \ln(Le/R)}{2 Le T_0}$$

$$K = \frac{(0.0833')^2 \ln(12'/0.333')}{2(12')(0.1528 d)}$$

$$= \frac{(0.0069 Ft^2)\, 3.58}{3.667 \text{ Ft-days}}$$

$$\boxed{K = 0.0067 \text{ Ft/day}}$$

r = radius of well casing = 2" = 0.0833'
R = radius of well screen = 4" = 0.3333'
Le = length of well screen = 12'
T_0 = time taken for water level to rise to 37% of initial change

h_0 = water level immediately after slug added or removed
h = height of water level above or below SWL at time t

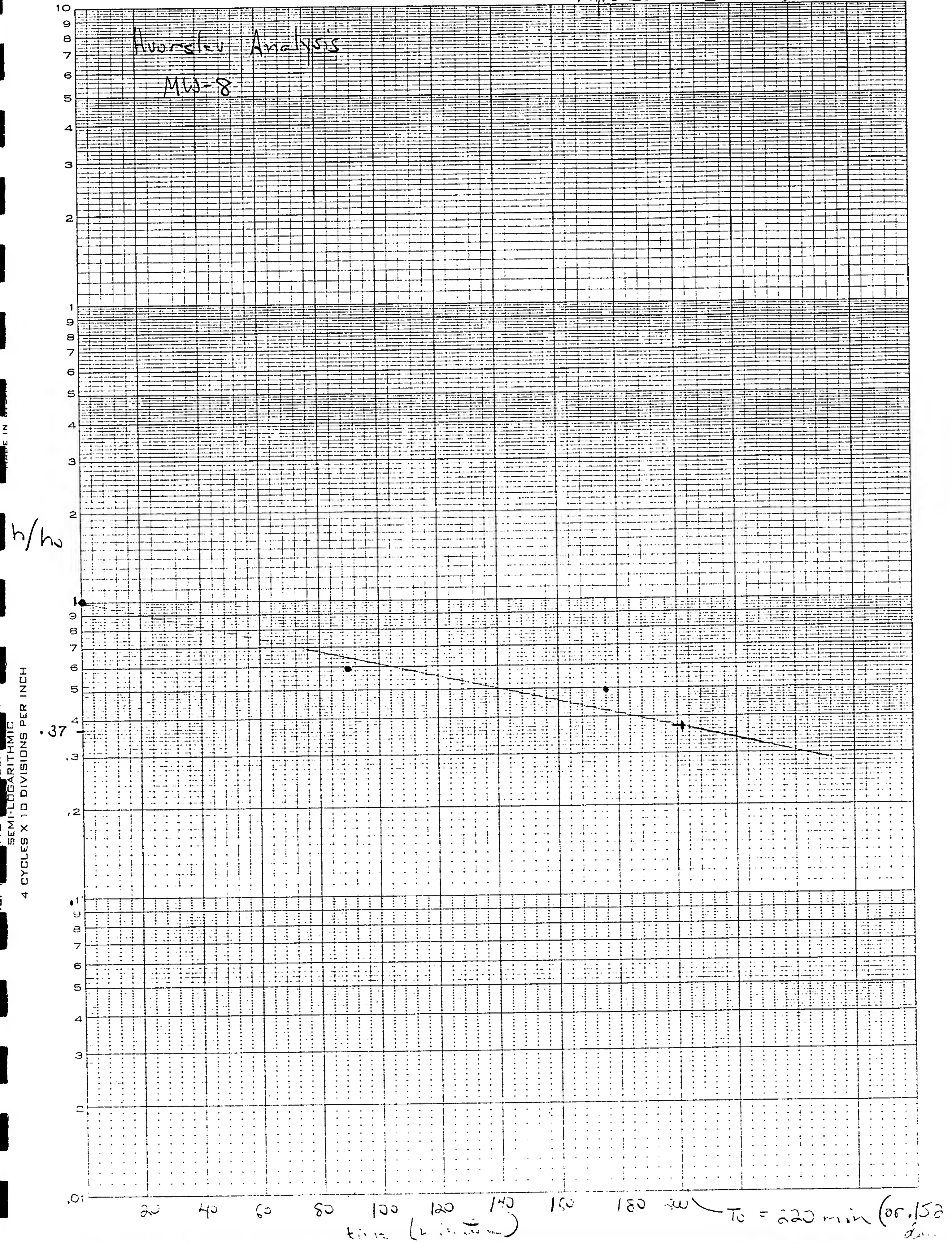
	Time	Water level below TOC (h)		h/h_0
0	1100	h_0 = h =	29.5	1.0
90 min	12:30	h =	17.34	0.588
176 min	1356	h =	14.56	0.494

T_0 = 220 min or 0.1528 days — see attached plot

$\boxed{\text{Well MW-8}}$

Myrtle beach
725522.04000
MCR 4/26/96

myrtle beach 725522.04000



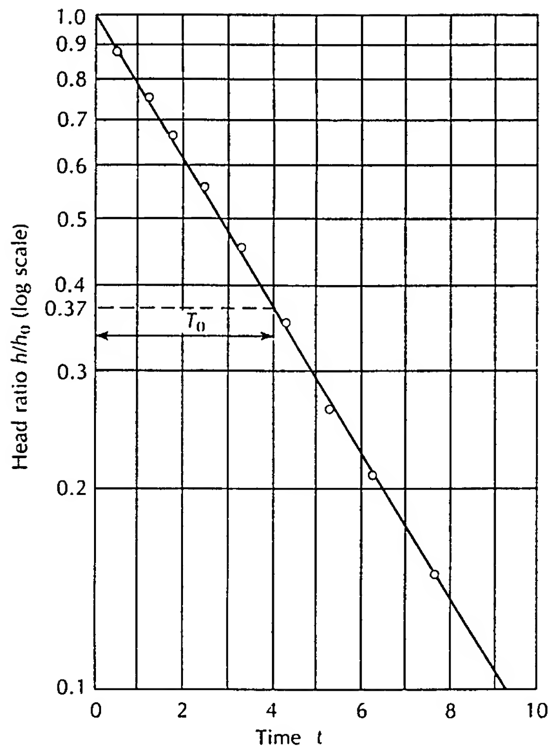


FIGURE 7.22 Plot of head ratio versus time used for Hvorslev method.

on semilogarithmic paper, as shown in Figure 7.22. The time-drawdown data should plot on a straight line.

If the length of the piezometer is more than 8 times the radius of the well screen ($L_e/R > 8$), the following formula applies:

$$K = \frac{r^2 \ln(L_e/R)}{2L_e T_0} \tag{7-85}$$

where

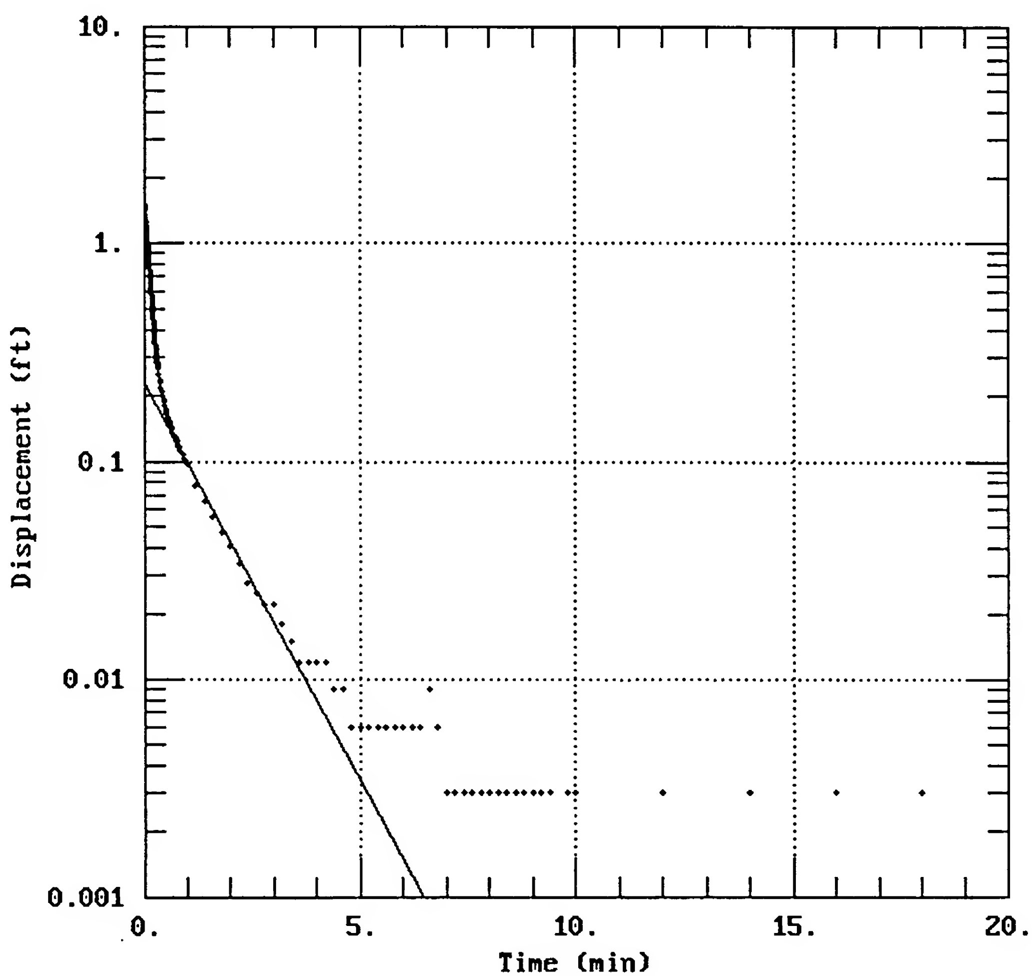
- K is hydraulic conductivity (L/T; ft/day, m/day, or cm/s)
- r is the radius of the well casing (L; ft, m, or cm)
- R is the radius of the well screen (L; ft, m, or cm)
- L_e is the length of the well screen (L; ft, m, or cm)
- T_0 is the time it takes for the water level to rise or fall to 37 percent of the initial change (Figure 7.22) (T; day or s)

Equation 7–85 is but one of many formulas presented by Hvorslev for differing piezometer geometry and aquifer conditions. However, it is one that is

CLIENT: MYRTLE BEACH AFB | COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW09 | PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW09



DATA SET:
FALLMW09.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 4.736 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 8.36 ft
b = 8.36 ft
H = 8.36 ft

PARAMETER ESTIMATES:
K = 6.631 ft/day
y0 = 0.2246 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V R E S U L T S
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

4/18/96 09:00:13

==

TEST DESCRIPTION

Data set........... FALLMW09.DAT
Output file........ FALLMW09.OUT
Data set title..... FALLING HEAD SLUG TEST MW09
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW09
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 4.736
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 8.36
   Well screen length............... 8.36
   Static height of water in well... 8.36
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.418
   Constants A, B and C............. 0.000 , 0.000, 1.817
   No. of observations.............. 190

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
K =	6.6314E+000	+/-	1.3762E-001	ft/day
y0 =	2.2457E-001	+/-	4.1349E-003	ft

ANALYSIS OF MODEL RESIDUALS

Residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals.............. 33
Number of estimated parameters.... 2
Degrees of freedom............... 31
Residual mean.................... 0.0006323
Residual standard deviation....... 0.002528
Residual variance................ 6.39E-006

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.8	0.116	0.11511	0.0008872	1
0.8166	0.116	0.11353	0.0024724	1
0.8333	0.113	0.11195	0.0010452	1
0.85	0.11	0.1104	-0.00040381	1
0.8666	0.11	0.10888	0.0011166	1
0.8833	0.11	0.10737	0.002625	1
0.9	0.107	0.10589	0.0011125	1
0.9166	0.104	0.10443	-0.00042926	1
0.9333	0.104	0.10298	0.0010175	1
0.95	0.101	0.10156	-0.00055585	1
0.9666	0.101	0.10016	0.00084269	1
0.9833	0.097	0.09877	-0.0017698	1
1	0.097	0.097401	-0.00040145	1
1.2	0.078	0.082415	-0.0044152	1
1.4	0.066	0.069735	-0.0037347	1
1.6	0.056	0.059005	-0.0030053	1
1.8	0.047	0.049927	-0.0029267	1
2	0.041	0.042245	-0.0012449	1
2.2	0.034	0.035745	-0.0017451	1
2.4	0.028	0.030245	-0.0022453	1
2.6	0.025	0.025592	-0.00059174	1
2.8	0.022	0.021654	0.00034583	1
3	0.022	0.018322	0.0036776	1
3.2	0.018	0.015503	0.0024967	1
3.4	0.015	0.013118	0.001882	1
3.6	0.012	0.0111	0.00090036	1
3.8	0.012	0.0093918	0.0026082	1
4	0.012	0.0079468	0.0040532	1
4.2	0.012	0.0067241	0.0052759	1
4.4	0.009	0.0056895	0.0033105	1
4.6	0.009	0.0048141	0.0041859	1
4.8	0.006	0.0040734	0.0019266	1
5	0.006	0.0034467	0.0025533	1

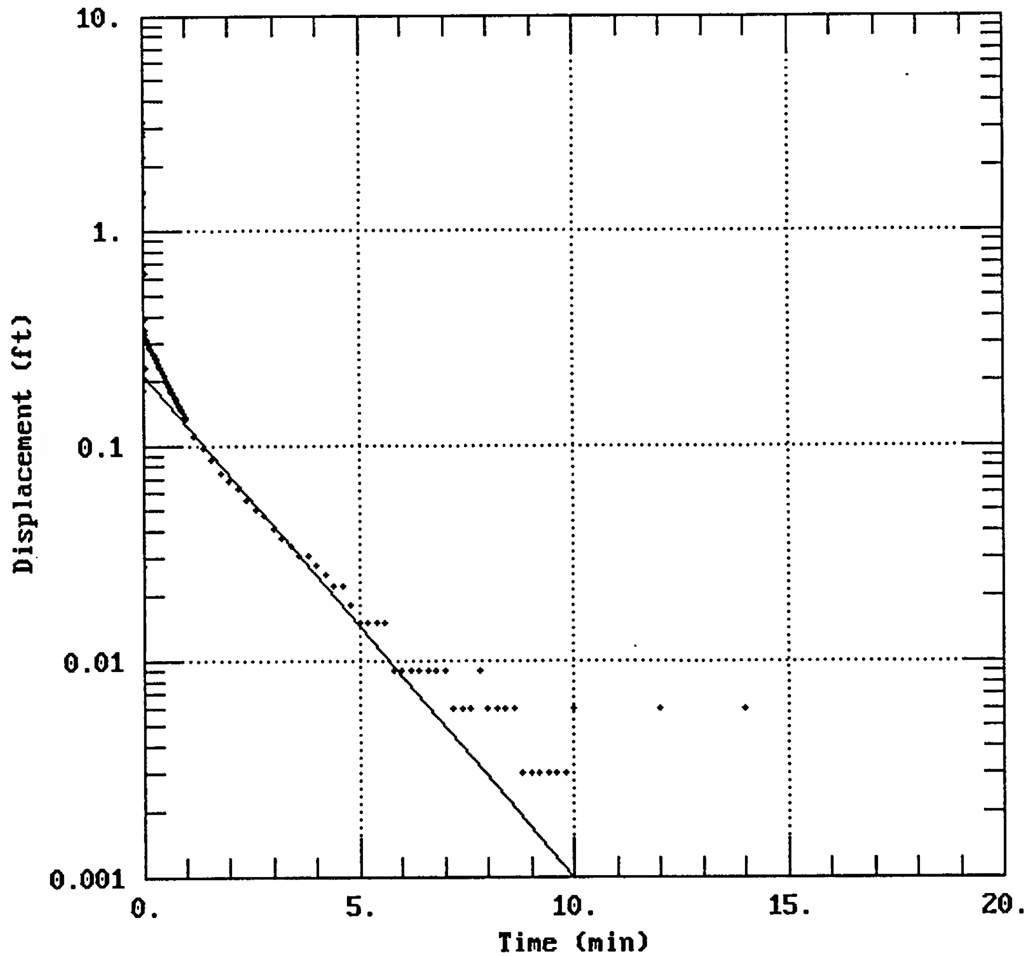
RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	6.6314E+000 ft/day
y0 =	2.2457E-001 ft

CLIENT: MYRTLE BEACH AFB	COMPANY: PARSONS ENGINEERING SCIENCE
LOCATION: MW09	PROJECT: 725522.04000

RISING HEAD SLUG TEST MW09



DATA SET:
RISEMW09.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3.23 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 8.36 ft
b = 8.36 ft
H = 8.36 ft

PARAMETER ESTIMATES:
K = 4.262 ft/day
y0 = 0.2101 ft

AQTESOLV

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

A Q T E S O L V   R E S U L T S

Version 2.01

Developed by Glenn M. Duffield

04/18/96 09:0

TEST DESCRIPTION

Data set........... RISEMW09.DAT
Output file........ RISEMW09.OUT
Data set title..... RISING HEAD SLUG TEST MW09
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW09
Test date.......... AUGUST 14, 1995

Units of Measurement
Length.......... ft
Time............ min

Test Well Data
Initial displacement in well..... 3.23
Radius of well casing............ 0.08333
Radius of wellbore............... 0.333
Aquifer saturated thickness...... 8.36
Well screen length............... 8.36
Static height of water in well... 8.36
Gravel pack porosity............. 0.3
Effective well casing radius..... 0.1953
Effective wellbore radius........ 0.333
Log(Re/Rw)....................... 2.418
Constants A, B and C............. 0.000 , 0.000, 1.817
No. of observations.............. 185

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error
K =	4.2616E+000	+/-	1.1800E-001 ft/day
y0 =	2.1009E-001	+/-	6.0956E-003 ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:

- Number of residuals............... 21
- Number of estimated parameters.... 2
- Degrees of freedom................ 19
- Residual mean..................... 0.0003877
- Residual standard deviation....... 0.003327
- Residual variance................. 1.107E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.132	0.12282	0.0091834	1
1.2	0.11	0.11031	-0.00031356	1
1.4	0.097	0.099083	-0.0020834	1
1.6	0.085	0.088996	-0.0039965	1
1.8	0.075	0.079936	-0.0049365	1
2	0.069	0.071799	-0.0027988	1
2.2	0.063	0.064489	-0.0014895	1
2.4	0.056	0.057924	-0.0019243	1
2.6	0.05	0.052027	-0.0020275	1
2.8	0.047	0.046731	0.00026902	1
3	0.041	0.041974	-0.00097367	1
3.2	0.037	0.037701	-0.00070066	1
3.4	0.034	0.033863	0.00013735	1
3.6	0.031	0.030415	0.00058464	1
3.8	0.031	0.027319	0.003681	1
4	0.028	0.024538	0.0034621	1
4.2	0.025	0.02204	0.0029601	1
4.4	0.022	0.019796	0.0022038	1
4.6	0.022	0.017781	0.0042191	1
4.8	0.018	0.015971	0.0020293	1
5	0.015	0.014345	0.00065512	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

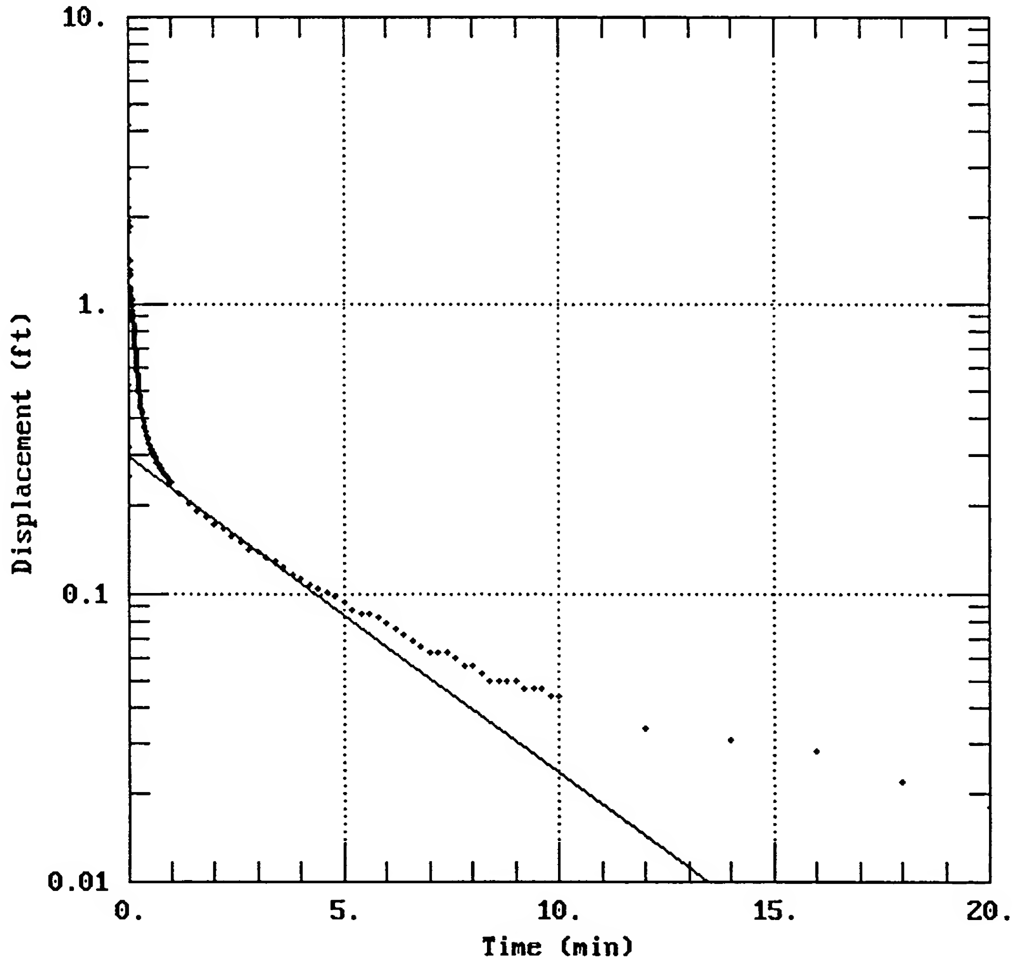
	Estimate
K =	4.2616E+000 ft/day
y0 =	2.1009E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

CLIENT: MYRTLE BEACH AFB | COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW10 | PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW10



DATA SET:
FALLMW10.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 4.92 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 9.65 ft
b = 9.65 ft
H = 9.65 ft

PARAMETER ESTIMATES:
K = 1.817 ft/day
y0 = 0.2946 ft

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                       A Q T E S O L V   R E S U L T S
                                Version 2.01

                       Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

4/18/96                                                                09:44:26

================================================================================
                                  TEST DESCRIPTION

Data set........... FALLMW10.DAT
Output file........ FALLMW10.OUT
Data set title..... FALLING HEAD SLUG TEST MW10
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW10
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 4.92
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 9.65
   Well screen length............... 9.65
   Static height of water in well... 9.65
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.541
   Constants A, B and C............. 0.000 ,   0.000,   1.937
   No. of observations.............. 190

================================================================================
                                  ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

              Estimate          Std.  Error
   K  =    1.8171E+000 +/-    5.8848E-002 ft/day
   y0 =    2.9464E-001 +/-    5.4082E-003 ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals...............	16
Number of estimated parameters....	2
Degrees of freedom................	14
Residual mean.....................	8.984E-005
Residual standard deviation.......	0.004644
Residual variance.................	2.157E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.24	0.22914	0.010859	1
1.2	0.221	0.2179	0.0030954	1
1.4	0.205	0.20722	-0.002219	1
1.6	0.192	0.19706	-0.0050574	1
1.8	0.183	0.18739	-0.0043942	1
2	0.173	0.1782	-0.0052048	1
2.2	0.167	0.16947	-0.002466	1
2.4	0.158	0.16116	-0.0031558	1
2.6	0.151	0.15325	-0.002253	1
2.8	0.142	0.14574	-0.0037378	1
3	0.139	0.13859	0.00040883	1
3.2	0.132	0.13179	0.00020504	1
3.4	0.129	0.12533	0.003668	1
3.6	0.123	0.11919	0.003814	1
3.8	0.116	0.11334	0.0026586	1
4	0.113	0.10778	0.0052166	1

===

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	1.8171E+000 ft/day
y0 =	2.9464E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

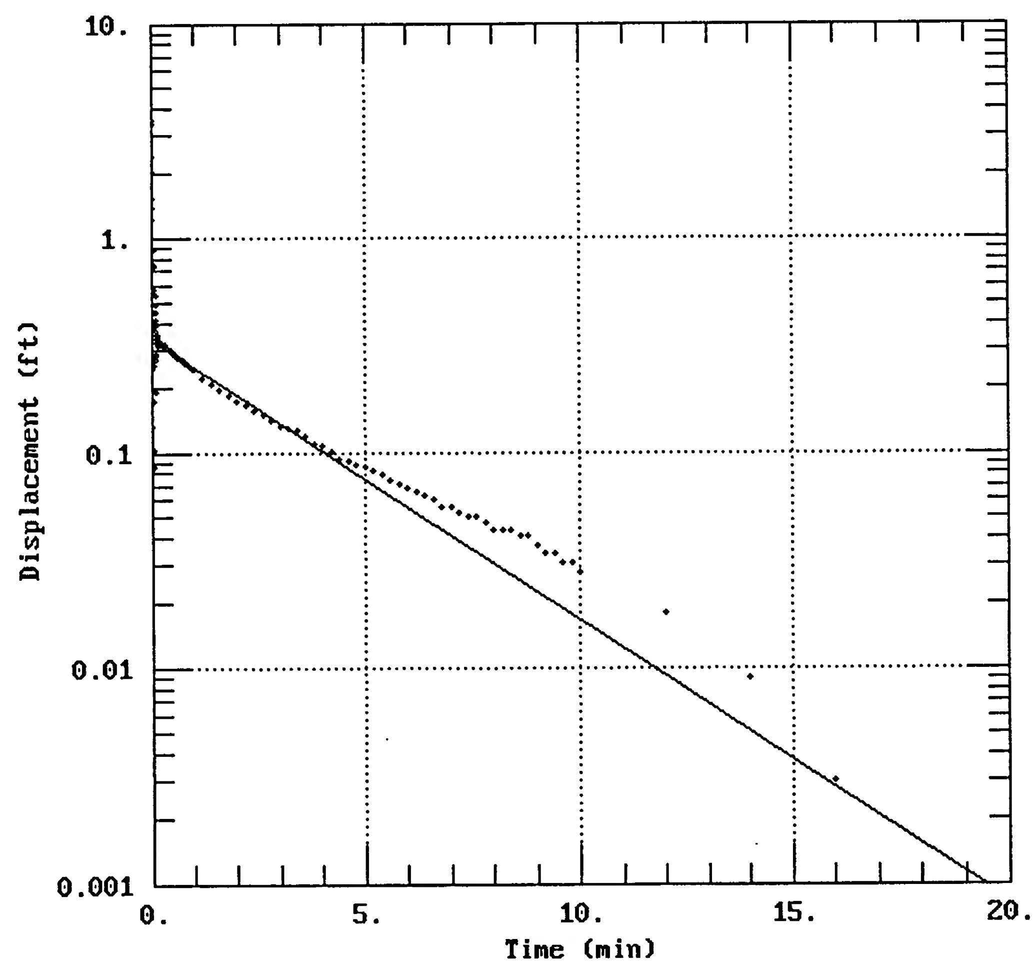
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW10

PROJECT: 725522.04000

RISING HEAD SLUG TEST MW10



DATA SET:
RISEMW10.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3.572 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 9.65 ft
b = 9.65 ft
H = 9.65 ft

PARAMETER ESTIMATES:
K = 2.156 ft/day
y0 = 0.331 ft

AQTESOLV

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

A Q T E S O L V   R E S U L T S

Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

04/18/96 10:01

TEST DESCRIPTION

```
Data set........... RISEMW10.DAT
Output file........ RISEMW10.OUT
Data set title..... RISING HEAD SLUG TEST MW10
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW10
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3.572
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 9.65
   Well screen length............... 9.65
   Static height of water in well... 9.65
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.541
   Constants A, B and C............. 0.000 ,  0.000,  1.937
   No. of observations.............. 186
```

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

```
           Estimate          Std. Error
  K  =   2.1556E+000 +/-   3.3180E-002 ft/day
  y0 =   3.3095E-001 +/-   1.8982E-003 ft
```

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:

```
   Number of residuals............... 51
   Number of estimated parameters.... 2
   Degrees of freedom................ 49
   Residual mean..................... 0.0002647
   Residual standard deviation....... 0.005505
   Residual variance................. 3.03E-005
```

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.5	0.293	0.28511	0.0078937	1
0.5166	0.29	0.2837	0.0063017	1
0.5333	0.287	0.28229	0.0047111	1
0.55	0.287	0.28089	0.0061135	1
0.5666	0.284	0.2795	0.0045007	1
0.5833	0.284	0.27811	0.0058893	1
0.6	0.281	0.27673	0.0042709	1
0.6166	0.278	0.27536	0.0026375	1
0.6333	0.278	0.27399	0.0040056	1
0.65	0.274	0.27263	0.0013668	1
0.6666	0.274	0.27129	0.0027132	1
0.6833	0.271	0.26994	0.001061	1
0.7	0.271	0.2686	0.002402	1
0.7166	0.268	0.26727	0.00072849	1
0.7333	0.268	0.26594	0.0020563	1
0.75	0.265	0.26462	0.00037755	1
0.7666	0.262	0.26332	-0.0013156	1
0.7833	0.262	0.26201	-7.4532E-006	1
0.8	0.259	0.26071	-0.0017058	1
0.8166	0.259	0.25942	-0.0004183	1
0.8333	0.259	0.25813	0.00087052	1
0.85	0.255	0.25685	-0.0018471	1
0.8666	0.255	0.25558	-0.00057865	1
0.8833	0.252	0.25431	-0.0023089	1
0.9	0.249	0.25305	-0.0040455	1
0.9166	0.249	0.2518	-0.0027958	1
0.9333	0.249	0.25054	-0.0015449	1
0.95	0.246	0.2493	-0.0033002	1
0.9666	0.246	0.24807	-0.002069	1
0.9833	0.243	0.24684	-0.0038366	1
1	0.243	0.24561	-0.0026103	1
1.2	0.221	0.23139	-0.010389	1
1.4	0.208	0.21799	-0.0099908	1
1.6	0.195	0.20537	-0.010369	1
1.8	0.183	0.19348	-0.010477	1
2	0.173	0.18227	-0.0092745	1
2.2	0.164	0.17172	-0.0077203	1
2.4	0.154	0.16178	-0.0077773	1
2.6	0.148	0.15241	-0.00441	1
2.8	0.139	0.14359	-0.0045851	1
3	0.132	0.13527	-0.0032712	1
3.2	0.129	0.12744	0.0015614	1
3.4	0.126	0.12006	0.0059404	1
3.6	0.12	0.11311	0.0068921	1
3.8	0.11	0.10656	0.0034414	1

4	0.107	0.10039	0.0066114	1
4.2	0.101	0.094576	0.0064241	1
4.4	0.094	0.0891	0.0049003	1
4.6	0.091	0.083941	0.0070594	1
4.8	0.088	0.07908	0.0089197	1
5	0.085	0.074501	0.010499	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

```
           Estimate
   K  =   2.1556E+000 ft/day
   y0 =   3.3095E-001 ft
```

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

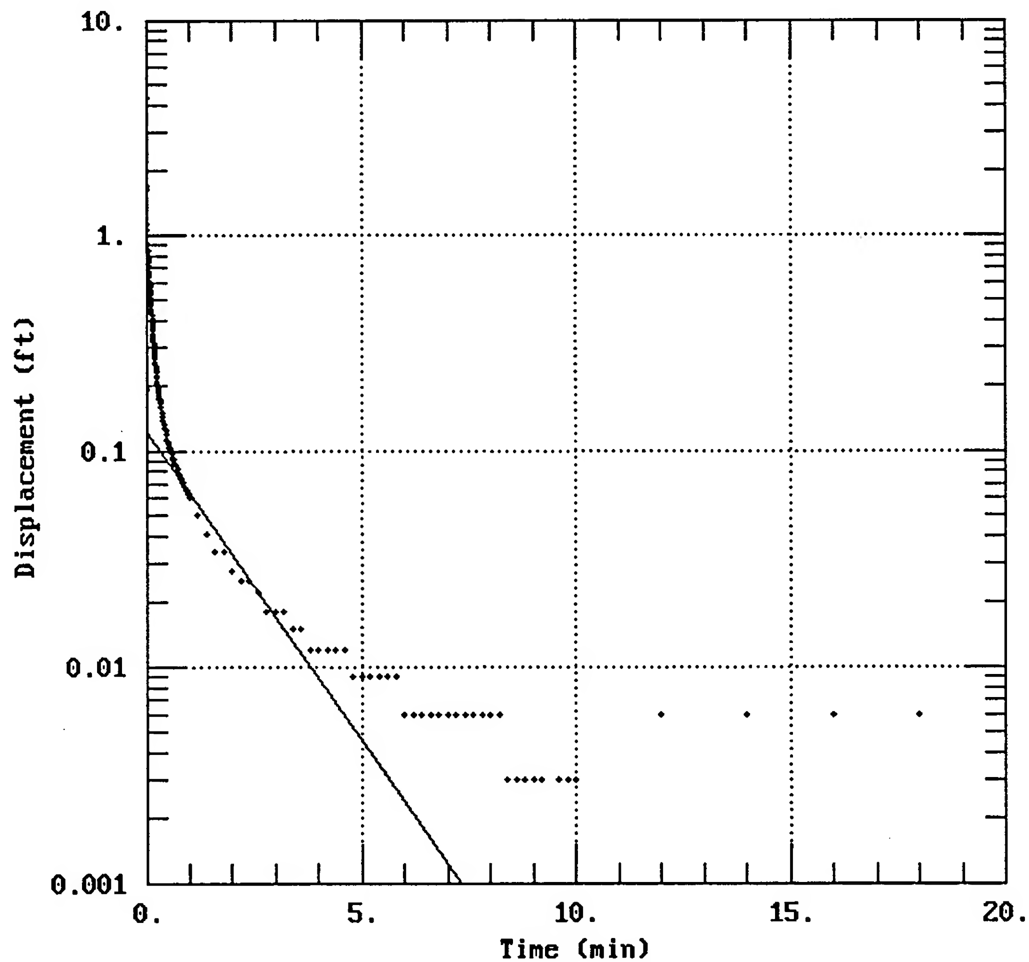
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW11

PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW11



DATA SET:
FALLMW11.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 4.36 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 7.44 ft
b = 7.44 ft
H = 7.44 ft

PARAMETER ESTIMATES:
K = 5.606 ft/day
y0 = 0.1204 ft

AQTESOLV

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

A Q T E S O L V   R E S U L T S

Version 2.01

Developed by Glenn M. Duffield

04/18/96 10:07

===

TEST DESCRIPTION

Data set........... FALLMW11.DAT
Output file........ FALLMW11.OUT
Data set title..... FALLING HEAD SLUG TEST MW11
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW11
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 4.36
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 7.44
   Well screen length............... 7.44
   Static height of water in well... 7.44
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.317
   Constants A, B and C............. 0.000 , 0.000, 1.732
   No. of observations.............. 188

===

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

===

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error
K =	5.6060E+000	+/-	2.4645E-001 ft/day
y0 =	1.2038E-001	+/-	4.0379E-003 ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:

```
   Number of residuals.............. 33
   Number of estimated parameters.... 2
   Degrees of freedom............... 31
   Residual mean.................... 0.0006506
   Residual standard deviation....... 0.003621
   Residual variance................ 1.311E-005
```

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.8	0.075	0.071238	0.0037617	1
0.8166	0.075	0.070467	0.004533	1
0.8333	0.072	0.069699	0.0023005	1
0.85	0.072	0.06894	0.0030597	1
0.8666	0.069	0.068194	0.00080611	1
0.8833	0.069	0.067451	0.0015489	1
0.9	0.066	0.066716	-0.00071646	1
0.9166	0.066	0.065994	5.8808E-006	1
0.9333	0.066	0.065275	0.00072468	1
0.95	0.066	0.064564	0.0014357	1
0.9666	0.063	0.063865	-0.0008653	1
0.9833	0.063	0.06317	-0.00016969	1
1	0.06	0.062482	-0.0024817	1
1.2	0.05	0.054801	-0.0048014	1
1.4	0.041	0.048065	-0.0070652	1
1.6	0.034	0.042157	-0.008157	1
1.8	0.034	0.036975	-0.002975	1
2	0.028	0.03243	-0.00443	1
2.2	0.025	0.028444	-0.0034437	1
2.4	0.025	0.024947	5.2585E-005	1
2.6	0.022	0.021881	0.00011913	1
2.8	0.018	0.019191	-0.0011913	1
3	0.018	0.016832	0.0011677	1
3.2	0.018	0.014763	0.0032368	1
3.4	0.015	0.012949	0.0020515	1
3.6	0.015	0.011357	0.0036431	1
3.8	0.012	0.0099609	0.0020391	1
4	0.012	0.0087365	0.0032635	1
4.2	0.012	0.0076626	0.0043374	1
4.4	0.012	0.0067207	0.0052793	1
4.6	0.012	0.0058946	0.0061054	1
4.8	0.009	0.00517	0.00383	1
5	0.009	0.0045345	0.0044655	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

```
          Estimate
 K  =   5.6060E+000 ft/day
 y0 =   1.2038E-001 ft
```

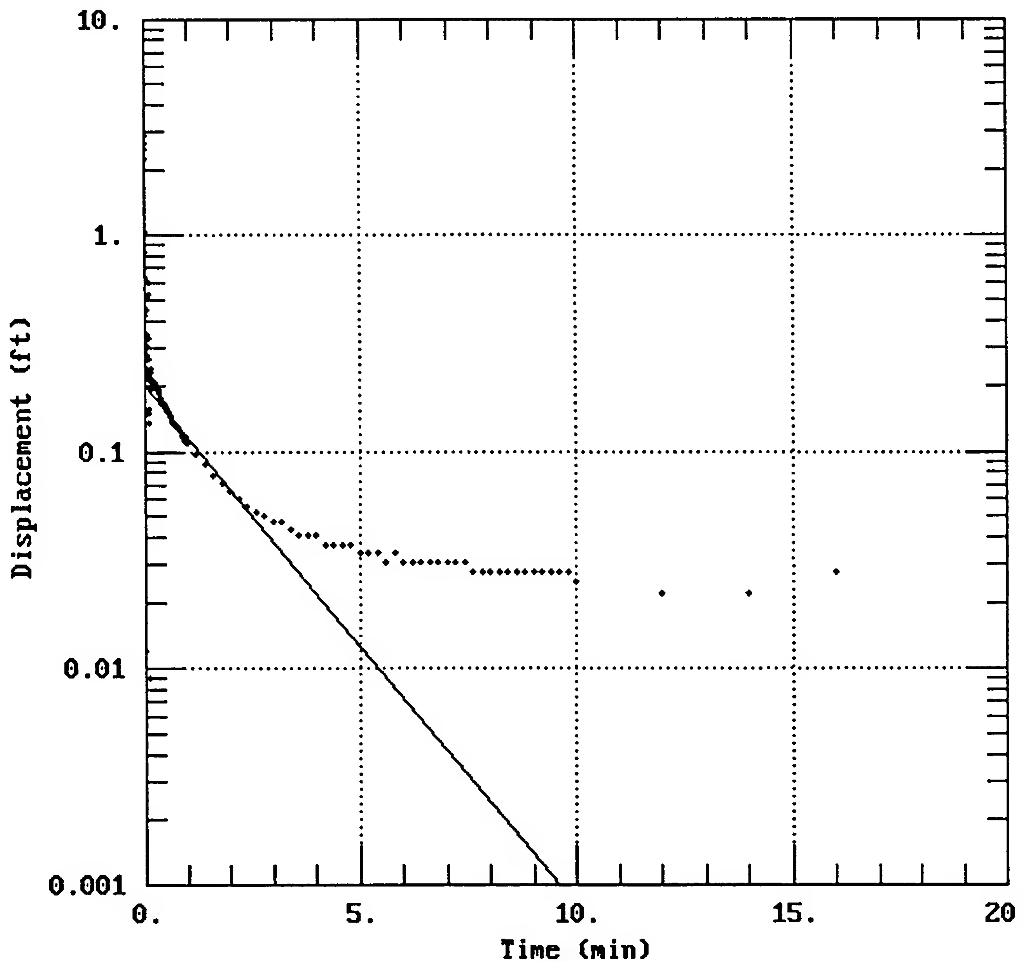
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW11

PROJECT: 725522.04000

RISING HEAD SLUG TEST MW11



DATA SET:
RISEMW11.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.872 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 7.44 ft
b = 7.44 ft
H = 7.44 ft

PARAMETER ESTIMATES:
K = 4.726 ft/day
y0 = 0.197 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S

Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

4/18/96 10:19:48

==

TEST DESCRIPTION

Data set........... RISEMW11.DAT
Output file........ RISEMW11.OUT
Data set title..... RISING HEAD SLUG TEST MW11
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW11
Test date.......... AUGUST 14, 1995

Units of Measurement
  Length.......... ft
  Time............ min

Test Well Data
  Initial displacement in well..... 2.872
  Radius of well casing............ 0.08333
  Radius of wellbore............... 0.333
  Aquifer saturated thickness...... 7.44
  Well screen length............... 7.44
  Static height of water in well... 7.44
  Gravel pack porosity............. 0.3
  Effective well casing radius..... 0.1953
  Effective wellbore radius........ 0.333
  Log(Re/Rw)....................... 2.317
  Constants A, B and C............. 0.000 , 0.000, 1.732
  No. of observations.............. 183

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
K =	4.7260E+000	+/-	1.2843E-001	ft/day
y0 =	1.9701E-001	+/-	2.5942E-003	ft

ANALYSIS OF MODEL RESIDUALS

Residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals.............. 41
Number of estimated parameters.... 2
Degrees of freedom............... 39
Residual mean.................... 0.0002041
Residual standard deviation....... 0.003929
Residual variance................ 1.544E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.5	0.157	0.14943	0.0075726	1
0.5166	0.154	0.14806	0.0059376	1
0.5333	0.151	0.1467	0.0042984	1
0.55	0.151	0.14535	0.0056466	1
0.5666	0.148	0.14403	0.0039744	1
0.5833	0.145	0.1427	0.0022981	1
0.6	0.145	0.14139	0.0036095	1
0.6166	0.142	0.1401	0.0019012	1
0.6333	0.138	0.13881	-0.0008113	1
0.65	0.138	0.13754	0.0004644	1
0.6666	0.135	0.13628	-0.0012792	1
0.6833	0.135	0.13503	-2.6733E-005	1
0.7	0.135	0.13379	0.0012142	1
0.7166	0.132	0.13256	-0.00056363	1
0.7333	0.132	0.13135	0.00065465	1
0.75	0.129	0.13014	-0.0011383	1
0.7666	0.129	0.12895	5.0605E-005	1
0.7833	0.126	0.12776	-0.0017643	1
0.8	0.126	0.12659	-0.00059015	1
0.8166	0.123	0.12543	-0.0024337	1
0.8333	0.123	0.12428	-0.0012809	1
0.85	0.12	0.12314	-0.0031388	1
0.8666	0.12	0.12201	-0.0020139	1
0.8833	0.116	0.12089	-0.0048925	1
0.9	0.116	0.11978	-0.0037815	1
0.9166	0.116	0.11869	-0.0026873	1
0.9333	0.113	0.1176	-0.0045965	1
0.95	0.113	0.11652	-0.0035158	1
0.9666	0.11	0.11545	-0.0054514	1
0.9833	0.11	0.11439	-0.0043903	1
1	0.11	0.11334	-0.0033391	1
1.2	0.097	0.10148	-0.0044751	1
1.4	0.088	0.090853	-0.002853	1
1.6	0.078	0.081343	-0.0033427	1
1.8	0.072	0.072828	-0.00082802	1
2	0.066	0.065205	0.0007954	1
2.2	0.06	0.058379	0.0016208	1
2.4	0.056	0.052268	0.0037318	1
2.6	0.053	0.046797	0.0062031	1
2.8	0.05	0.041898	0.0081016	1
3	0.047	0.037513	0.0094874	1

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

```
          Estimate
K  =   4.7260E+000 ft/day
y0 =   1.9701E-001 ft
```

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

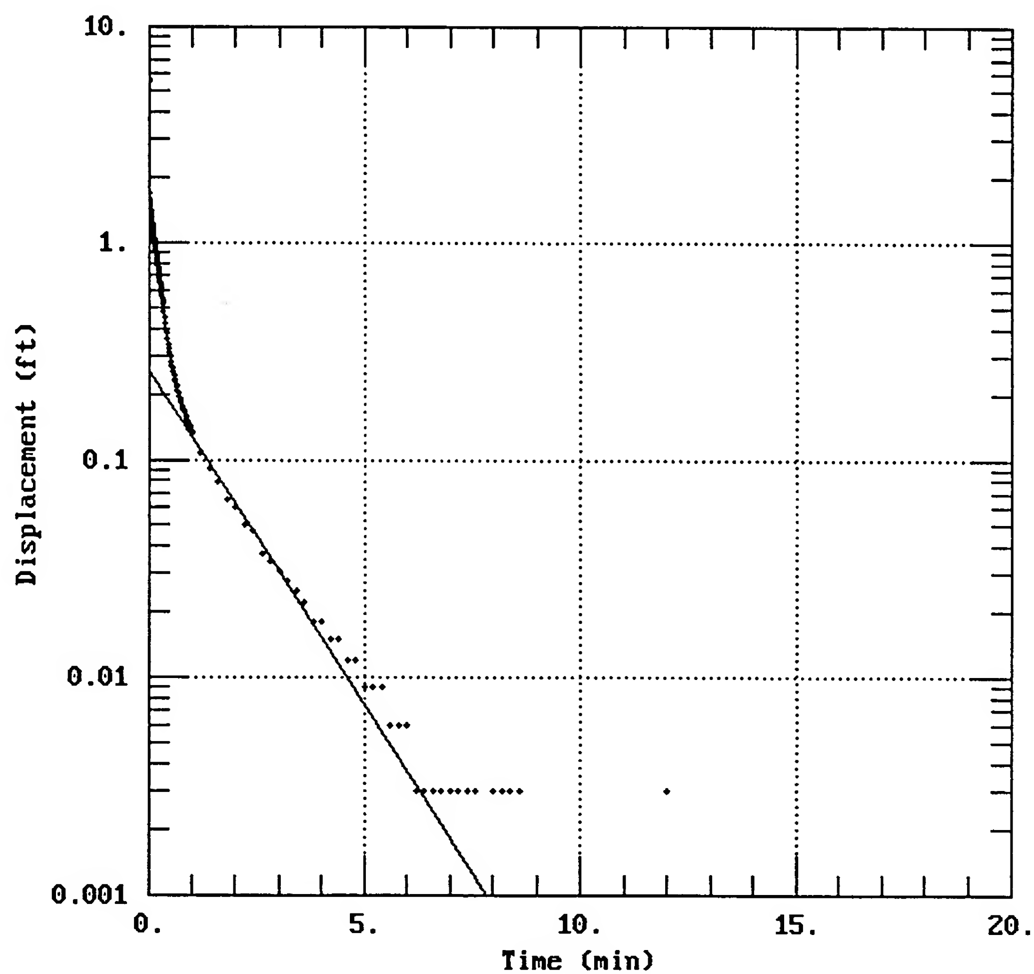
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW13

PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW13



DATA SET:
FALLMW13.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 5.6 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 7.35 ft
b = 7.35 ft
H = 7.35 ft

PARAMETER ESTIMATES:
K = 6.09 ft/day
y0 = 0.2524 ft

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

4/18/96                                                                       10:23:49

==========================================================================================
                                  TEST DESCRIPTION

Data set........... FALLMW13.DAT
Output file........ FALLMW13.OUT
Data set title..... FALLING HEAD SLUG TEST MW13
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW13
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 5.6
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 7.35
   Well screen length............... 7.35
   Static height of water in well... 7.35
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.306
   Constants A, B and C............. 0.000 ,  0.000,  1.724
   No. of observations.............. 178

==========================================================================================
                                  ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========================================================================================
                       RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

            Estimate          Std.  Error
  K  =    6.0903E+000 +/-    1.5992E-001 ft/day
  y0 =    2.5242E-001 +/-    8.0696E-003 ft

ANALYSIS OF MODEL RESIDUALS

Residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals.............. 21
Number of estimated parameters.... 2
Degrees of freedom............... 19
Residual mean.................... 0.0005964
Residual standard deviation...... 0.003072
Residual variance................ 9.437E-006

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.132	0.12447	0.0075305	1
1.2	0.107	0.10806	-0.0010565	1
1.4	0.091	0.093808	-0.0028077	1
1.6	0.079	0.081438	-0.0024379	1
1.8	0.066	0.070699	-0.0046992	1
2	0.06	0.061377	-0.0013765	1
2.2	0.05	0.053283	-0.0032832	1
2.4	0.047	0.046257	0.00074292	1
2.6	0.037	0.040157	-0.0031574	1
2.8	0.034	0.034862	-0.00086213	1
3	0.031	0.030265	0.00073492	1
3.2	0.028	0.026274	0.0017258	1
3.4	0.025	0.02281	0.0021904	1
3.6	0.022	0.019802	0.0021982	1
3.8	0.018	0.017191	0.0008093	1
4	0.018	0.014924	0.0030761	1
4.2	0.015	0.012956	0.0020441	1
4.4	0.015	0.011248	0.0037525	1
4.6	0.012	0.0097644	0.0022356	1
4.8	0.012	0.0084768	0.0035232	1
5	0.009	0.007359	0.001641	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

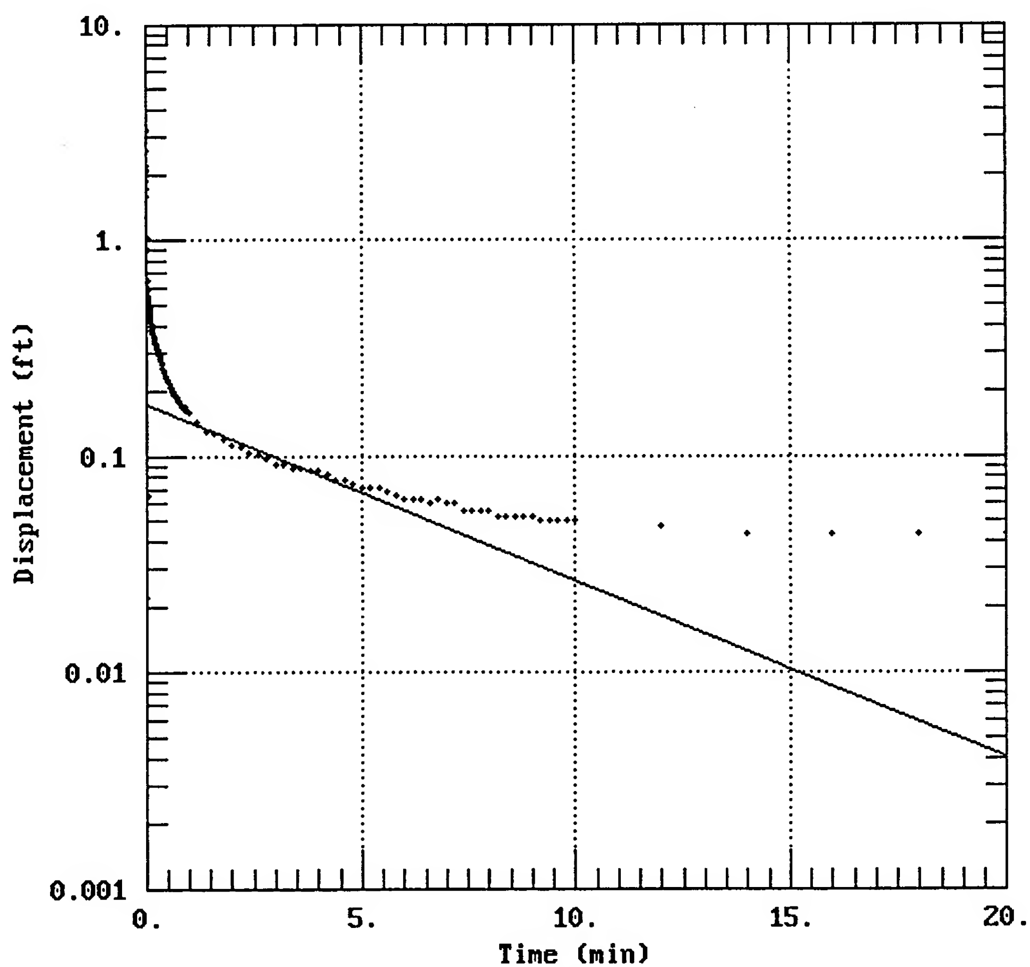
Estimate
K =   6.0903E+000 ft/day
y0 =   2.5242E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

CLIENT: MYRTLE BEACH AFB | COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW13 | PROJECT: 725522.04000

RISING HEAD SLUG TEST MW13



DATA SET:
RISEMW13.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3.278 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 7.35 ft
b = 7.35 ft
H = 7.35 ft

PARAMETER ESTIMATES:
K = 1.612 ft/day
y0 = 0.1718 ft

AQTESOLV

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

A Q T E S O L V   R E S U L T S
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

04/18/96 10:29

==

TEST DESCRIPTION

```
Data set........... RISEMW13.DAT
Output file........ RISEMW13.OUT
Data set title..... RISING HEAD SLUG TEST MW13
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW13
Test date.......... AUGUST 14, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3.278
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 7.35
   Well screen length............... 7.35
   Static height of water in well... 7.35
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.306
   Constants A, B and C............. 0.000 ,  0.000,  1.724
   No. of observations.............. 206
```

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

```
          Estimate          Std.  Error
   K  =   1.6118E+000 +/-   8.8707E-002 ft/day
   y0 =   1.7177E-001 +/-   4.8012E-003 ft
```

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:

```
   Number of residuals.............. 21
   Number of estimated parameters.... 2
   Degrees of freedom................ 19
   Residual mean..................... 0.0001022
   Residual standard deviation....... 0.005519
   Residual variance................. 3.046E-005
```

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.158	0.14245	0.015547	1
1.2	0.142	0.13722	0.0047794	1
1.4	0.129	0.13218	-0.0031803	1
1.6	0.126	0.12733	-0.0013251	1
1.8	0.12	0.12265	-0.0026482	1
2	0.113	0.11814	-0.0051431	1
2.2	0.11	0.1138	-0.0038036	1
2.4	0.104	0.10962	-0.0056234	1
2.6	0.101	0.1056	-0.0045967	1
2.8	0.097	0.10172	-0.004718	1
3	0.091	0.097982	-0.0069817	1
3.2	0.091	0.094383	-0.0033827	1
3.4	0.088	0.090916	-0.0029159	1
3.6	0.088	0.087576	0.00042362	1
3.8	0.085	0.08436	0.00064044	1
4	0.085	0.081261	0.0037391	1
4.2	0.082	0.078276	0.0037239	1
4.4	0.078	0.075401	0.0025991	1
4.6	0.078	0.072631	0.0053687	1
4.8	0.075	0.069963	0.0050366	1
5	0.072	0.067394	0.0046065	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

```
          Estimate
  K  =   1.6118E+000 ft/day
  y0 =   1.7177E-001 ft
```

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

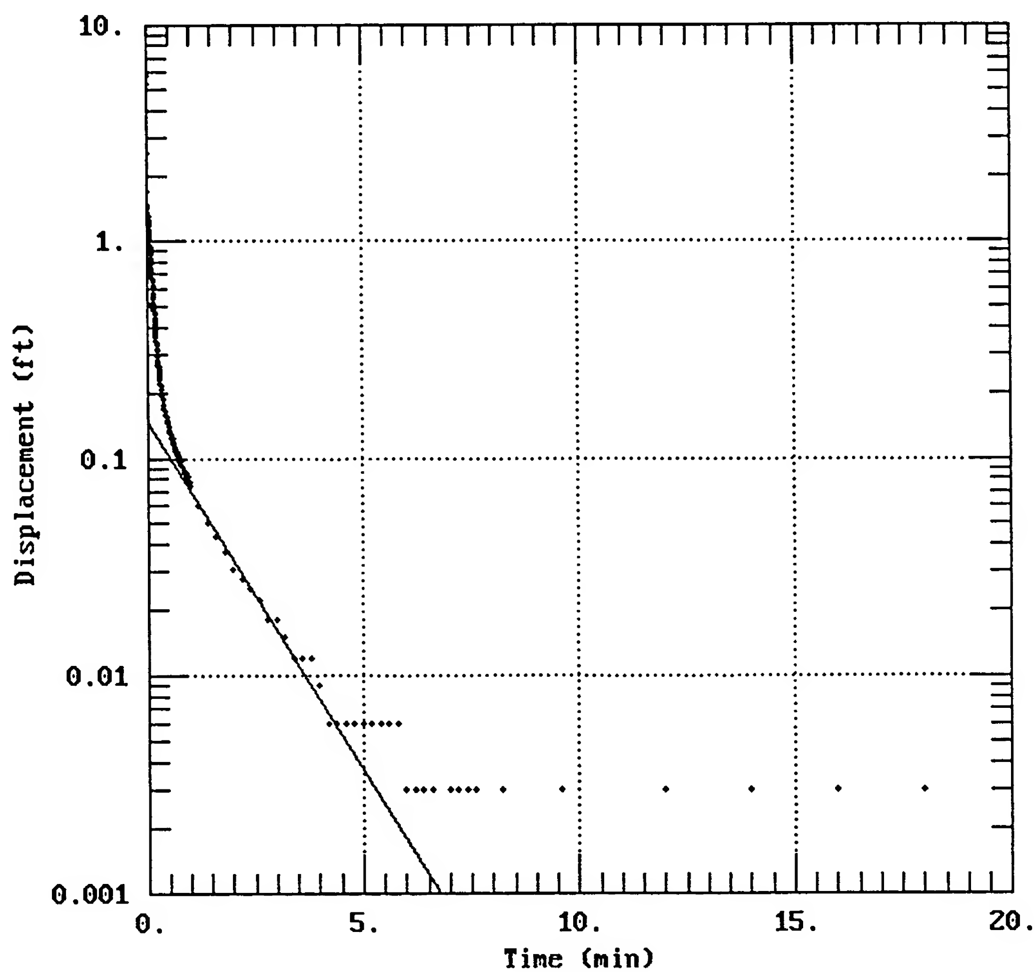
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW17

PROJECT: 725522.04000

FALLING HEAD SLUG TEST MW17



DATA SET:
FALLMW17.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 5.806 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 6.79 ft
b = 6.79 ft
H = 6.79 ft

PARAMETER ESTIMATES:
K = 6.652 ft/day
y0 = 0.1467 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S

Version 2.01

4/18/96 10:35:48

==

TEST DESCRIPTION

Data set........... FALLMW17.DAT
Output file........ FALLMW17.OUT
Data set title..... FALLING HEAD SLUG TEST MW17
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW17
Test date.......... AUGUST 15, 1995

Units of Measurement
Length.......... ft
Time............ min

Test Well Data
Initial displacement in well..... 5.806
Radius of well casing............ 0.08333
Radius of wellbore............... 0.333
Aquifer saturated thickness...... 6.79
Well screen length............... 6.79
Static height of water in well... 6.79
Gravel pack porosity............. 0.3
Effective well casing radius..... 0.1953
Effective wellbore radius........ 0.333
Log(Re/Rw)....................... 2.238
Constants A, B and C............. 0.000 , 0.000, 1.673
No. of observations.............. 178

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
K =	6.6520E+000	+/-	1.9575E-001	ft/day
y0 =	1.4673E-001	+/-	5.3691E-003	ft

ANALYSIS OF MODEL RESIDUALS

Residual = observed - calculated

weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 21
Number of estimated parameters.... 2
Degrees of freedom................ 19
Residual mean..................... 0.0003365
Residual standard deviation....... 0.001927
Residual variance................. 3.713E-006

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.075	0.07034	0.0046596	1
1.2	0.06	0.060722	-0.00072159	1
1.4	0.05	0.052418	-0.0024181	1
1.6	0.044	0.04525	-0.0012502	1
1.8	0.037	0.039062	-0.0020624	1
2	0.031	0.033721	-0.0027208	1
2.2	0.028	0.02911	-0.0011096	1
2.4	0.025	0.025129	-0.00012896	1
2.6	0.022	0.021693	0.00030732	1
2.8	0.018	0.018726	-0.00072629	1
3	0.018	0.016166	0.0018345	1
3.2	0.015	0.013955	0.001045	1
3.4	0.012	0.012047	-4.6682E-005	1
3.6	0.012	0.010399	0.0016007	1
3.8	0.012	0.0089773	0.0030227	1
4	0.009	0.0077497	0.0012503	1
4.2	0.006	0.0066899	-0.00068993	1
4.4	0.006	0.0057751	0.00022489	1
4.6	0.006	0.0049854	0.0010146	1
4.8	0.006	0.0043037	0.0016963	1
5	0.006	0.0037151	0.0022849	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	6.6520E+000 ft/day
y0 =	1.4673E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

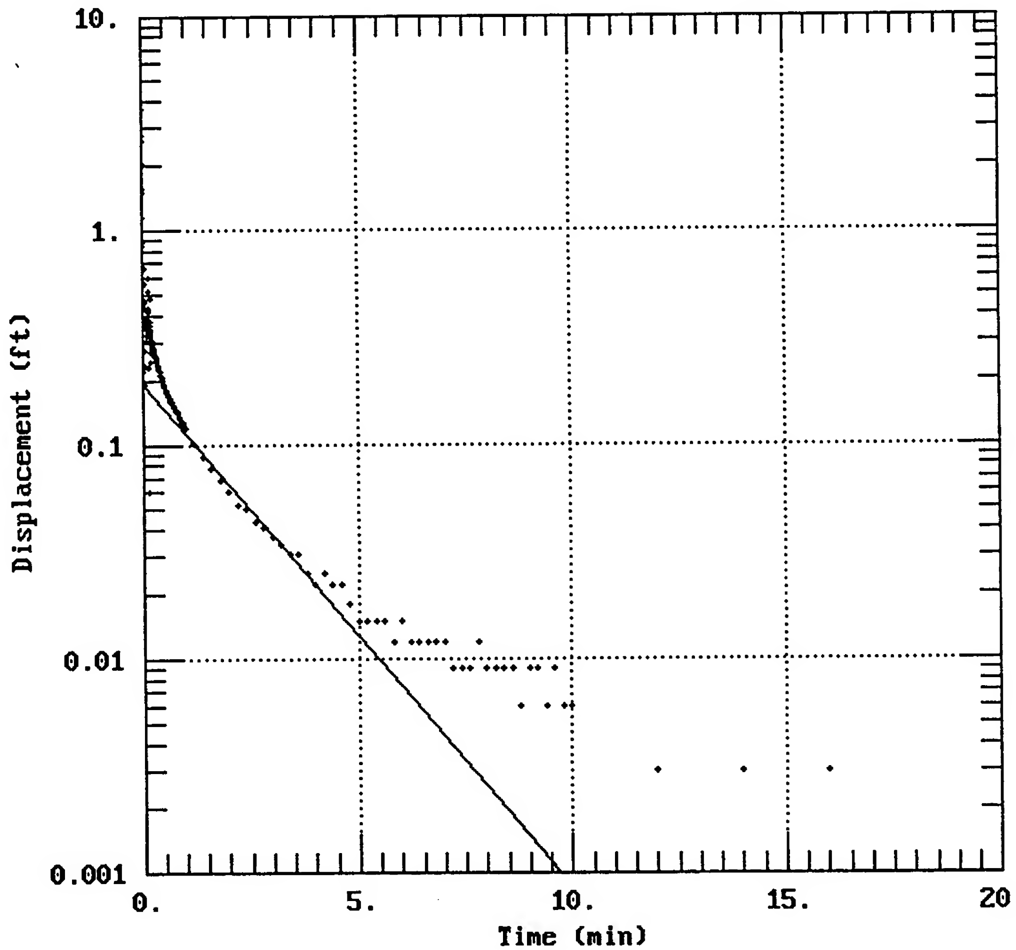
CLIENT: MYRTLE BEACH AFB

COMPANY: PARSONS ENGINEERING SCIENCE

LOCATION: MW17

PROJECT: 725522.04000

RISING HEAD SLUG TEST MW17



DATA SET:
RISEMW17.DAT
04/18/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3.736 ft
r_c= 0.08333 ft
r_w= 0.333 ft
L = 6.79 ft
b = 6.79 ft
H = 6.79 ft

PARAMETER ESTIMATES:
K = 4.885 ft/day
y0 = 0.1911 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                                Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

04/18/96                                                                  10:40

================================================================================
                               TEST DESCRIPTION

Data set........... RISEMW17.DAT
Output file........ RISEMW17.OUT
Data set title..... RISING HEAD SLUG TEST MW17
Company............ PARSONS ENGINEERING SCIENCE
Project............ 725522.04000
Client............. MYRTLE BEACH AFB
Location........... MW17
Test date.......... AUGUST 15, 1995

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3.736
   Radius of well casing............ 0.08333
   Radius of wellbore............... 0.333
   Aquifer saturated thickness...... 6.79
   Well screen length............... 6.79
   Static height of water in well... 6.79
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1953
   Effective wellbore radius........ 0.333
   Log(Re/Rw)....................... 2.238
   Constants A, B and C............. 0.000 ,  0.000,  1.673
   No. of observations.............. 185

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

            Estimate          Std. Error
   K  =   4.8855E+000 +/-   1.7141E-001 ft/day
   y0 =   1.9107E-001 +/-   7.0476E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals...............	21
Number of estimated parameters....	2
Degrees of freedom................	19
Residual mean.....................	0.0005206
Residual standard deviation.......	0.003821
Residual variance.................	1.46E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	0.12	0.11134	0.0086556	1
1.2	0.101	0.099946	0.0010539	1
1.4	0.088	0.089715	-0.0017146	1
1.6	0.078	0.080531	-0.0025305	1
1.8	0.069	0.072287	-0.0032866	1
2	0.06	0.064887	-0.0048867	1
2.2	0.053	0.058244	-0.0052442	1
2.4	0.05	0.052282	-0.0022818	1
2.6	0.044	0.04693	-0.0029297	1
2.8	0.041	0.042126	-0.0011255	1
3	0.037	0.037813	-0.00081313	1
3.2	0.034	0.033942	5.7793E-005	1
3.4	0.031	0.030468	0.00053245	1
3.6	0.031	0.027349	0.0036514	1
3.8	0.025	0.024549	0.00045108	1
4	0.022	0.022036	-3.585E-005	1
4.2	0.025	0.01978	0.00522	1
4.4	0.022	0.017755	0.0042448	1
4.6	0.022	0.015938	0.0060624	1
4.8	0.018	0.014306	0.003694	1
5	0.015	0.012842	0.0021585	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	4.8855E+000 ft/day
y0 =	1.9107E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

APPENDIX E

SCDHEC AND EPA REGION 3 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)/RISK-BASED CONCENTRATIONS (RBCs)

South Carolina

DHEC

Department of Health and Environmental Control

RISK-BASED CORRECTIVE ACTION FOR PETROLEUM RELEASES

June, 1995

RISK-BASED SCREENING LEVELS LOOK-UP TABLES

The RBSL for benzene, toluene, ethylbenzene, and xylenes in ground water are based upon the Maximum Contaminant Levels (MCL) published in the Environmental Protection Agency **Drinking Water Regulations and Health Advisories.** The RBSL for soil were calculated using the leachability model included in Appendix B. Please note that some of the RBSL for the PAHs in soil and ground water were adjusted such that they do not exceed reporting levels that are reasonably obtainable using the equipment that it is available to a majority of the certified laboratories. Assumptions for calculation of soil RBSL were:

- total organic carbon: 100 mg/kg
- ground-water recharge rate: 25 cm/yr
- organic/water partitioning coefficient: published literature
- porosity: for sandy soil - .47, for clay soil - .43
- bulk density: for sandy soil - 1.55 g/cc, for clay soil - 1.6 g/cc
- hydraulic conductivity: 1.65 x 10^{-5} for clay soil, 6.9 x 10^{-4} for sandy soil
- half-life biodegradation rate: published literature
- residual water content: for sandy soil - .06, for clay soil - .08
- wetting front section head: for sandy soil - (-10 cm), for clay soil - (-30 cm)

To account for the immediate dilution effect upon mixing of the leachate with ground water, dilution/attenuation factors (DAF) were calculated using mathematical modeling of simple dispersion/dilution phenomena. Sites with a lower hydraulic conductivity (clays) and higher hydraulic conductivity (sands) were shown to have DAF's of approximately 2 and 8, respectively; therefore, those values were adopted as default values used to calculate the RBSL.

TABLE 4 - **RBSL'S FOR GROUND WATER**

Chemical of Concern	Concentration (ug/l)
Benzene	5
Toluene	1000
Ethylbenzene	700
Xylenes	10,000
MTBE	40
Naphthalene	25
Benzo(a)anthracene	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10
Chrysene	10
Dibenz(a,h)anthracene	10

Table 5 RBSLs for Sandy Soil (mg/kg) ($K \geq 10^{-3}$ cm/sec - DAF = 8)

Chemical of Concern	Concentration (mg/kg)
Benzene	0.007
Toluene	1.7
Ethylbenzene	1.5
Xylenes	44
Naphthalene	0.2
Benzo(a)anthracene	0.7
Benzo(b)flouranthene	0.66
Benzo(k)flouranthene	4.6
Chrysene	0.66
Dibenz(a,h)anthracene	2.6

Note: Depth to ground water does not significantly affect calculation of RBSL for sandy soil.

Table 6 RBSLs for Clay-rich Soil (mg/kg) ($K \leq 10^{-4}$ cm/sec - DAF = 2)

Depth to GW → ↓ COC	<5 ft	5-10 ft	10-15 ft	15-20 ft	20-25 ft	25-30 ft	>30 ft
Benzene	0.003	0.013	0.052	0.23	1.02	4.69	21.8
Toluene	0.73	1.88	5.26	15.3	45.8	139	425
Ethylbenzene	1.19	9.6	92.7	978.0	10,853	124,517	-
Xylenes	16.9	35.5	80.0	185.9	440	1,053	2,542
Naphthalene	0.07	0.11	0.17	0.28	0.47	0.78	1.31
Benzo(a)anthracene	0.66	0.66	0.66	0.66	0.66	0.66	0.72
Benzo(b)flouranthene	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Benzo(k)flouranthene	1.26	1.49	1.79	2.17	2.63	3.20	3.90
Chrysene	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Dibenz(a,h)anthracene	0.72	0.84	1.00	1.19	1.43	1.72	2.08

Note: Depth to ground water is measured from the depth of the worst case soil sample to the water table.

Table 7 RBSLs for Inhalation of vapors

COC	RBSL (ug/m^3)
Benzene	.22
Toluene	420
Ethylbenzene	1000
Xylene	730
Methyl Tert-Butyl Ether	3100

Note: RBSLs for the PAHs are not of concern because of their low volatility.

Table 8 RBSLs for Ingestion or Dermal Contact with Surficial Soil

COC	Residential (mg/kg)	Commercial (mg/kg)
Benzene	22	99
Toluene	16,000	200,000
Ethylbenzene	7,800	100,000
Xylene	160,000	1,000,000
Methyl Tert-Butyl Ether	390	5100
Naphthalene	3100	41,000
Benzo(a)anthracene	.88	3.9
Benzo(b)fluoranthene	.88	3.9
Benzo(k)fluoranthene	8.8	39
Chrysene	88	390
Dibenz(a,h)anthracene	.088	.39

EPA Region III Risk-Based Concentration Table

Background Information

Roy L. Smith, Ph.D.
Toxicologist

EPA

Development of Risk-Based Concentrations

General

Separate carcinogenic and non-carcinogenic risk-based concentrations were calculated for each compound for each pathway. The concentration in the table is the lower of the two, rounded to two significant figures. The following terms and values were used in the calculations:

Exposure variables	Value	Symbol
General:		
Carcinogenic potency slope oral (risk per mg/kg/d):	*	CPSo
Carcinogenic potency slope inhaled (risk per mg/kg/d):	*	CPSi
Reference dose oral (mg/kg/d):	*	RfDo
Reference dose inhaled (mg/kg/d):	*	RfDi
Target cancer risk:	1e-06	TR
Target hazard quotient:	1	THQ
Body weight, adult (kg):	70	BWa
Body weight, age 1-6 (kg):	15	BWc
Averaging time carcinogens (d):	25550	ATc
Averaging time non-carcinogens (d):	ED*365	ATn
Inhalation, adult (m3/d):	20	IRAa
Inhalation, child (m3/d):	12	IRAc
Inhalation factor, age-adjusted (m3-y/kg-d):	11.66	IFAadj
Tap water ingestion, adult (L/d):	2	IRWa
Tap water ingestion, age 1-6 (L/d):	1	IRWc
Tap water ingestion factor, age-adjusted (L-y/kg-d):	1.09	IFWadj
Fish ingestion (g/d):	54	IRF
Soil ingestion, adult (mg/d):	100	IRSa
Soil ingestion, age 1-6 (mg/d):	200	IRSc
Soil ingestion factor, age adjusted (mg-y/kg-d):	114.29	IFSadj
Residential:		
Exposure frequency (d/y):	350	EFr
Exposure duration, total (y):	30	EDtot
Exposure duration, age 1-6 (y):	6	EDc
Volatilization factor (L/m3):	0.5	K

Exposure variables	**Value**	**Symbol**
Occupational:		
Exposure frequency (d/y):	250	EFo
Exposure duration (y):	25	EDo
Fraction of contaminated soil ingested (unitless)	0.5	FC

*: Contaminant-specific toxicological constants. The priority among sources of toxicological constants was as follows: (1) IRIS, (2) HEAST, (3) HEAST alternative method, (4) EPA-NCEA Superfund Health Risk Technical Support Center, (5) withdrawn from IRIS or HEAST, and (6) other EPA documents. Each source was used only if numbers from higher-priority sources were unavailable. The EPA Superfund Health Risk Technical Support Center, part of the EPA National Center for Environmental Assessment in Cincinnati, develops provisional RfDs and CPSs on request for contaminants not in IRIS or HEAST. These provisional values are labeled "E = EPA-NCEA provisional" in the table. It is possible they may be obsolete. If one of the "E" constants is important to a Superfund risk assessment, consider requesting, through a Regional risk assessor, a new provisional value.

Age-adjusted factors

Because contact rates with tap water, ambient air, and residential soil are different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors. These factors approximated the integrated exposure from birth until age 30 by combining contact rates, body weights, and exposure durations for two age groups - small children and adults. The age-adjusted factor for soil was obtained from RAGS IB; the others were developed by analogy.

Air inhalation

$$IFAadj\ \frac{m^3 \cdot y}{kg \cdot d} = \frac{EDc \cdot IRAc}{BWc} + \frac{(EDtot - EDc) \cdot IRAa}{BWa}$$

Tap water ingestion

$$IFWadj\ \frac{L \cdot y}{kg \cdot d} = \frac{EDc \cdot IRWc}{BWc} + \frac{(EDtot - EDc) \cdot IRWa}{BWa}$$

Soil ingestion

$$IFSadj\ \frac{mg \cdot y}{kg \cdot d} = \frac{EDc \cdot IRSc}{BWc} + \frac{(EDtot - EDc) \cdot IRSa}{BWa}$$

Residential water

Volatilization terms were calculated only for compounds with a mark in the "VOC" column. Compounds having a Henry's Law constant greater than 10^{-5} were considered volatile. The list may be incomplete, but is unlikely to include false positives. The equations and the volatilization factor (K, above) were obtained from RAGS IB. Oral potency slopes and reference doses were used for both oral and inhaled exposures for volatile compounds lacking inhalation values. Inhaled potency slopes were substituted for unavailable oral potency slopes only for volatile compounds; inhaled RfDs were substituted for unavailable

oral RfDs for both volatile and non-volatile compounds. RBCs for carcinogens were based on combined childhood and adult exposure; for non-carcinogens RBCs were based on adult exposure.

Carcinogens

$$RBC\ \tfrac{\mu g}{L} = \frac{TR \cdot ATc \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot ([K \cdot IFAadj \cdot CPSi] + [IFWadj \cdot CPSo])}$$

Non-carcinogens

$$RBC\ \tfrac{\mu g}{L} = \frac{THQ \cdot BWa \cdot ATn \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot EDtot \cdot \left(\frac{K \cdot IRAa}{RfDi} + \frac{IRWa}{RfDo}\right)}$$

Ambient air

Oral potency slopes and references were used where inhalation values were not available. RBCs for carcinogens were based on combined childhood and adult exposure; for non-carcinogens RBCs were based on adult exposure.

Carcinogens

$$RBC\ \tfrac{\mu g}{m^3} = \frac{TR \cdot ATc \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot IFAadj \cdot CPSi}$$

Non-carcinogens

$$RBC\ \tfrac{\mu g}{m^3} = \frac{THQ \cdot RfDi \cdot BWa \cdot ATn \cdot 1000\ \frac{\mu g}{mg}}{EFr \cdot EDtot \cdot IRAa}$$

Edible fish

All RBCs were based on adult exposure.

Carcinogens

$$RBC\ \tfrac{mg}{kg} = \frac{TR \cdot BWa \cdot ATc}{EFr \cdot EDtot \cdot \frac{IRF}{1000\ \frac{g}{kg}} \cdot CPSo}$$

Non-carcinogens

$$RBC\ \tfrac{mg}{kg} = \frac{THQ \cdot RfDo \cdot BWa \cdot ATn}{EFr \cdot EDtot \cdot \frac{IRF}{1000\ \frac{g}{kg}}}$$

Commercial/industrial soil ingestion

RBCs were based on adult occupational exposure, including an assumption that only 50% of total soil ingestion is work-related.

Carcinogens

$$RBC\ \tfrac{mg}{kg} = \frac{TR\ BWa\ ATc}{EFo \cdot EDo \cdot \frac{IRSa}{10^6\ \frac{mg}{kg}} \cdot FC \cdot CPSo}$$

Non-carcinogens

$$RBC\ \tfrac{mg}{kg} = \frac{THQ \cdot RfDo \cdot BWa \cdot ATn}{EFo \cdot EDo \cdot \frac{IRSa}{10^6\ \frac{mg}{kg}} \cdot FC}$$

Residential soil ingestion

RBCs for carcinogens were based on combined childhood and adult exposure; RBCs for non-carcinogens were based on childhood exposure only.

Carcinogens

$$RBC\ \tfrac{mg}{kg} = \frac{TR \cdot ATc}{EFr \cdot \frac{IFSadj}{10^6\ \frac{mg}{kg}} \cdot CPSo}$$

Non-carcinogens

$$RBC\ \tfrac{mg}{kg} = \frac{THQ \cdot RfDo \cdot BWc \cdot ATn}{EFr \cdot EDc \cdot \frac{IRSc}{10^6\ \frac{mg}{kg}}}$$

Development of Soil Screening Levels

General

In December 1994 the EPA Office of Solid Waste and Emergency Response proposed Soil Screening Guidance (Document 9355.4-1, PB95-963530, EPA540/R-94/101, available through NTIS at 703-487-4650). This draft document provides (1) a framework in which soil screening levels are to be used, (2) a detailed methodology for calculating soil screening levels, and (3) soil screening levels for 107 substances.

Consistent with this new guidance, the risk-based concentration table now includes two columns of generic soil screening levels (SSLs). OSWER's 107 proposed soil screening levels have been added verbatim. In addition, the proposed SSL methodology has been used to calculate soil screening levels for more substances, which are also included in the

new table. The table clearly distinguishes the OSWER SSLs from the "unofficial" ones.

These SSLs provide reasonable maximum estimates of transfers of contaminants from soil to other media. One column contains soil concentrations protective of groundwater quality; the other contains soil concentrations protective of air quality. "Protective" is defined in the same terms as the risk-based concentrations for tap water and air -- that residential contact scenarios will yield a fixed upper bound risk of 10^{-6} or a fixed hazard quotient of 1 (whichever occurs at the lower concentration).

OSWER's SSLs should be used only within the framework proposed in the guidance document. The additional SSLs included in the RBC table are intended for the same uses (although they obviously carry less weight than the formally proposed numbers).

The SSLs are based on the following assumptions:

Input variables	Value	Symbol*
Surface soil moisture content (g/g)	0.1	W_s
Vadose zone soil moisture content (kg/kg)	0.2	W_v
Surface soil bulk density (g/cm³)	1.5	ρ_{bs}
Vadose zone soil bulk density (kg/L)	1.5	ρ_{bv}
Surface soil particle density (g/cm³)	2.65	ρ_{ss}
Vadose zone soil particle density (g/cm³)	2.65	ρ_{sv}
Total surface soil porosity (L pore /L soil)	0.43	N_s
Total vadose zone soil porosity (L pore/L soil)	0.43	N_v
Air-filled surface soil porosity (L air/L soil)	0.28	θ_{as}
Water-filled surface soil porosity (L water/L soil)	0.15	θ_{ws}
Air-filled vadose zone soil porosity (L air/L soil)	0.13	θ_{av}
Water-filled vadose zone soil porosity (L water/L soil)	0.30	θ_{wv}
Organic carbon fraction of surface soil (g/g)	0.006	FOC_s
Organic carbon fraction of vadose zone soil (g/g)	0.002	FOC_v
Dispersion factor for 0.5 acres (g/m²s per kg/m³)	35.1	Q/C
Particulate emission factor (m³/kg)	6.79e+08	PEF
Exposure interval (s)	9.50e+08	T
Dilution-attenuation factor (unitless)	10	DAF

* - Symbols were adjusted, variables were rearranged, and derived and chemical-specific variables were omitted for simplicity and clarity. Presentation of the input variables in a single table using the same terms as in the OSWER SSL document would have been confusing. The terms used here are generally similar to OSWER's, and can easily be compared with the SSL guidance document.

With two exceptions described in the following section, SSL calculations were based on the same algorithms presented in the OSWER draft SSL guidance document. For details of the calculations (and for general background information on SSLs), I strongly recommend

consulting that document. The "unofficial" SSLs were developed under the following conditions:

Soil Screening Levels for Inhalation

Inhaled reference doses and potency slopes were used if available. If inhalation values were not available, oral RfDs and potency slopes were substituted. SSLs were calculated only for substances for which aqueous solubility, Koc, Henry's Law constant, and diffusivity in air were available. SSLs were calculated only for substances for which a volatilization factor could be calculated. This was done because OSWER's large proposed particulate emission factor rendered it pointless to estimate SSLs for particulate emissions alone. The final calculated SSL shown in the RBC table is the smaller of the risk-based SSL and the soil saturation concentration. All calculated SSLs were rounded to 2 significant figures.

The OSWER risk algorithms for inhalation were revised in order to be consistent with the rest of the RBC table. Only calculated SSLs were affected by this; SSLs proposed by OSWER are presented verbatim. Calculated SSLs for inhalation of carcinogens were based on an integrated lifetime exposure rather than adult exposure. SSLs for inhalation of noncarcinogens were based on adult exposure for 350 days per year rather than 365 days per year. The following algorithms were used to calculate inhalation SSLs:

Carcinogens

$$SSL\ \frac{mg}{kg} = \frac{TR \cdot ATc}{EFr \cdot IFAadj \cdot \left(\frac{1}{VF} + \frac{1}{PEF}\right) \cdot CPSi}$$

Non-carcinogens

$$SSL\ \frac{mg}{kg} = \frac{THQ \cdot BWa \cdot ATn \cdot RfDi}{EFr \cdot EDtot \cdot IRAa \cdot \left(\frac{1}{VF} + \frac{1}{PEF}\right)}$$

Soil Screening Levels for Groundwater Use

All algorithms were as proposed by OSWER. MCLs were used as target groundwater concentrations if available. If MCLs were unavailable the risk-based concentration in the "tap water" column of the RBC table was used as the target groundwater concentration. All SSLs for groundwater are based on a dilution-attenuation factor (DAF) of 10. Since these SSLs scale linearly with DAF, the SSLs for DAF=1 would be ten times lower. They were omitted to conserve space. All groundwater SSLs were rounded to 2 significant figures and capped at unity.

It has been NCEA's policy to deny requests for documentation of interim toxicity constants. Although Region 3 has sometimes provided this documentation on request, for the above-stated reasons we have no assurance that the documentation, or even the interim numbers, are current. We've decided to discontinue distributing information that may be misleading. If one of the "E"-coded contaminants is a major risk contributor at your site, we strongly suggest that you work with EPA to develop an up-to-date reference dose or slope factor.

CHANGES IN THIS ISSUE OF THE RBC TABLE

New or revised EPA toxicity constants are now marked with "**" before the contaminant name. This is to help users quickly pick out substances with new RBCs. Formerly these contaminants were printed in underlined boldface type that copied badly. A new basis code, "M" for MCL, has been added to the upper right corner of each page. This code denotes soil screening levels for groundwater protection that are based on EPA Maximum Contaminant Levels.

If you want to raise issues or get answers to questions about the RBC table, please call the Technical Support Help Line at 215-597-1116. The line has a voice mail system to take your calls if we're not available. We'll return your call as soon as we can. Please limit calls to RBC issues; if you have a question about applying RBCs to a site, please call the EPA Regional office handling the project. Thanks for your help and cooperation, and we hope the RBC table continues to be a useful resource.

Attachment

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis : C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.

Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Risk-Based Concentrations: Ambient Air µg/m3	Risk-Based Concentrations: Fish mg/kg	Risk-Based Concentrations: Soil Ingestion: Industrial mg/kg	Risk-Based Concentrations: Soil Ingestion: Residential mg/kg	Soil Screening Levels-Transfers from Soil to: Air mg/kg	Soil Screening Levels-Transfers from Soil to: Groundwater mg/kg
Acephate	30560191	4.00E-03 I		8.70E-03 I			7.7 C	0.72 C	0.36 C	660 C	73 C		
Acetaldehyde	75070		2.57E-03 I		7.70E-03 I		94 N	0.81 C					
Acetochlor	34256821	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Acetone	67641	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	62000 E	8 E
Acetone cyanohydrin	75865	7.00E-02 H	4.00E-02 A				2600 N	150 N	95 N	140000 N	5500 N		
Acetonitrile	75078	6.00E-03 I	1.43E-02 A				220 N	52 N	8.1 N	12000 N	470 N		
Acetophenone	98862	1.00E-01 I	5.71E-06 W			X	0.042 N	0.021 N	140 N	200000 N	7800 N		
Acifluorfen	62476599	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Acrolein	107028	2.00E-02 H	5.71E-06 I				730 N	0.021 N	27 N	41000 N	1600 N		
Acrylamide	79061	2.00E-04 I		4.50E+00 I	4.55E+00 I		0.015 C	0.0014 C	0.0007 C	1.3 C	0.14 C		
Acrylic acid	79107	5.00E-01 I	2.86E-04 I				18000 N	1 N	680 N	1000000 N	39000 N		
Acrylonitrile	107131	1.00E-03 H	5.71E-04 I	5.40E-01 I	2.38E-01 I		0.12 C	0.026 C	0.0058 C	11 C	1.2 C		
Alachlor	15972608	1.00E-02 I		8.00E-02 H			0.84 C	0.078 C	0.039 C	72 C	8 C		
Alar	1596845	1.50E-01 I					5500 N	550 N	200 N	310000 N	12000 N		
Aldicarb	116063	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N	570 S	0.036 M
Aldicarb sulfone	1646884	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Aldrin	309002	3.00E-05 I		1.70E+01 I	1.71E+01 I		0.004 C	0.00037 C	0.00019 C	0.34 C	0.038 C	0.5 E	0.005 E
Ally	74223646	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Allyl alcohol	107186	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Allyl chloride	107051	5.00E-02 W	2.86E-04 I				1800 N	1 N	68 N	100000 N	3900 N		
Aluminum	7429905	1.00E+00 E					37000 N	3700 N	1400 N	1000000 N	78000 N		
Aluminum phosphide	20859738	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Amdro	67485294	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Ametryn	834128	9.00E-03 I					330 N	33 N	12 N	18000 N	700 N		
m-Aminophenol	591275	7.00E-02 H					2600 N	260 N	95 N	140000 N	5500 N		
4-Aminopyridine	504245	2.00E-05 H					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Amitraz	33089611	2.50E-03 I					91 N	9.1 N	3.4 N	5100 N	200 N		
Ammonia	7664417		2.86E-02 I				1000 N	100 N					
Ammonium sulfamate	7773060	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Aniline	62533		2.86E-04 I	5.70E-03 I			10 N	1 N	0.55 C	1000 C	110 C	45 N	0.031 N
Antimony and compounds	7440360	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Antimony pentoxide	1314609	5.00E-04 H					18 N	1.8 N	0.68 N	1000 N	39 N		
Antimony potassium tartrate	304610	9.00E-04 H					33 N	3.3 N	1.2 N	1800 N	70 N		
Antimony tetroxide	1332316	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
Antimony trioxide	1309644	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
Apollo	74115245	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Aramite	140578	5.00E-02 H		2.50E-02 I	2.49E-02 I		2.7 C	0.25 C	0.13 C	230 C	26 C		
Arsenic	7440382	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N	380 E	15 E
Arsenic (as carcinogen)	7440382			1.50E+00 I	1.51E+01 I		0.045 C	0.00041 C	0.0021 C	3.8 C	0.43 C	380 E	15 E
Arsine	7784421		1.43E-05 I				0.52 N	0.052 N					
Assure	76578148	9.00E-03 I					330 N	33 N	12 N	18000 N	700 N		
Asulam	3337711	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Atrazine	1912249	3.50E-02 I		2.22E-01 H			0.3 C	0.028 C	0.014 C	26 C	2.9 C		
Avermectin B1	65195553	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Azobenzene	103333			1.10E-01 I	1.08E-01 I		0.61 C	0.058 C	0.029 C	52 C	5.8 C		
Barium and compounds	7440393	7.00E-02 I	1.43E-04 A				2600 N	0.52 N	95 N	140000 N	5500 N	350000 E	32 E

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
							Tap Water	Ambient Air	Fish	Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC				Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Baygon	114261	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Bayleton	43121433	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Baythroid	68359375	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Benefin	1861401	3.00E-01 I					11000 N	1100 N	410 N	610000 N	23000 N		
Benomyl	17804352	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Bentazon	25057890	2.50E-03 I					91 N	9.1 N	3.4 N	5100 N	200 N		
Benzaldehyde	100527	1.00E-01 I				x	610 N	370 N	140 N	200000 N	7800 N		
Benzene	71432		1.71E-03 E	2.90E-02 I	2.90E-02 I	x	0.36 C	0.22 C	0.11 C	200 C	22 C	0.5 E	0.02 E
Benzenethiol	108985	1.00E-05 H					0.37 N	0.037 N	0.014 N	20 N	0.78 N		
Benzidine	92875	3.00E-03 I		2.30E+02 I	2.35E+02 I		0.00029 C	0.000027 C	0.000014 C	0.025 C	0.0028 C	1.3 C	1.1E-06 C
Benzoic acid	65850	4.00E+00 I					150000 N	15000 N	5400 N	1000000 N	310000 N	320 S	280 E
Benzotrichloride	98077			1.30E+01 I			0.0052 C	0.00048 C	0.00024 C	0.44 C	0.049 C	0.012 C	0.000073 C
Benzyl alcohol	100516	3.00E-01 H					11000 N	1100 N	410 N	610000 N	23000 N		
Benzyl chloride	100447			1.70E-01 I		x	0.062 C	0.037 C	0.019 C	34 C	3.8 C	0.5 C	0.00036 C
Beryllium and compounds	7440417	5.00E-03 I		4.30E+00 I	8.40E+00 I		0.016 C	0.00075 C	0.00073 C	1.3 C	0.15 C	690 E	180 E
Bidrin	141662	1.00E-04 I					3.7 N	0.37 N	0.14 N	200 N	7.8 N		
Biphenthrin (Talstar)	82657043	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
1,1-Biphenyl	92524	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N	9000 S	110 N
Bis(2-chloroethyl)ether	111444			1.10E+00 I	1.16E+00 I	x	0.0092 C	0.0054 C	0.0029 C	5.2 C	0.58 C	0.3 E	0.0003 E
Bis(2-chloroisopropyl)ether	39638329	4.00E-02 I		7.00E-02 H	3.50E-02 H	x	0.26 C	0.18 C	0.045 C	82 C	9.1 C		
Bis(chloromethyl)ether	542881			2.20E+02 I	2.17E+02 I	x	0.000049 C	0.000029 C	0.000014 C	0.026 C	0.0029 C	0.000037 C	1E-07 C
Bis(2-chloro-1-methylethyl)ether				7.00E-02 W	7.00E-02 W		0.96 C	0.089 C	0.045 C	82 C	9.1 C		
Bis(2-ethylhexyl)phthalate (DEHP)	117817	2.00E-02 I		1.40E-02 I			4.8 C	0.45 C	0.23 C	410 C	46 C	210 E	11 E
Bisphenol A	80057	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Boron (and borates)	7440428	9.00E-02 I	5.71E-03 H				3300 N	21 N	120 N	180000 N	7000 N		
Boron trifluoride	7637072		2.00E-04 H				7.3 N	0.73 N					
Bromodichloromethane	75274	2.00E-02 I		6.20E-02 I		x	0.17 C	0.1 C	0.051 C	92 C	10 C	1800 E	0.3 E
Bromoethene	593602				1.10E-01 H	x	0.096 C	0.057 C					
Bromoform (tribromomethane)	75252	2.00E-02 I		7.90E-03 I	3.85E-03 I	x	2.4 C	1.6 C	0.4 C	720 C	81 C	46 E	0.5 E
Bromomethane	74839	1.40E-03 I	1.43E-03 I			x	8.7 N	5.2 N	1.9 N	2900 N	110 N	2 E	0.1 E
4-Bromophenyl phenyl ether	101553	5.80E-02 O					2100 N	210 N	78 N	120000 N	4500 N		
Bromophos	2104963	5.00E-03 H					180 N	18 N	6.8 N	10000 N	390 N		
Bromoxynil	1689845	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Bromoxynil octanoate	1689992	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
1,3-Butadiene	106990				9.80E-01 I	x	0.011 C	0.0064 C				0.0013 C	0.000072 C
1-Butanol	71363	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	9700 E	8 E
Butyl benzyl phthalate	85687	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N	530 E	68 E
Butylate	2008415	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
sec-Butylbenzene	135988	1.00E-02 E				x	61 N	37 N	14 N	20000 N	780 N	80 S	0.27 M
tert-Butylbenzene	104518	1.00E-02 E				x	61 N	37 N	14 N	20000 N	780 N		0.27 M
Butylphthalyl butylglycolate	85701	1.00E+00 I					37000 N	3700 N	1400 N	1000000 N	78000 N		
Cacodylic acid	75605	3.00E-03 H					110 N	11 N	4.1 N	6100 N	230 N		
Cadmium and compounds	7440439	5.00E-04 I	5.71E-05 W		6.30E+00 I		18 N	0.00099 C	0.68 N	1000 N	39 N	920 E	6 E
Caprolactam	105602	5.00E-01 I					18000 N	1800 N	680 N	1000000 N	39000 N		
Captafol	2425061	2.00E-03 I		8.60E-03 H			7.8 C	0.73 C	0.37 C	670 C	74 C		
Captan	133062	1.30E-01 I		3.50E-03 H			19 C	1.8 C	0.9 C	1600 C	180 C		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
							Tap Water	Ambient Air	Fish	Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC				Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Carbaryl	63252	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	0.34 S	23 N
Carbofuran	1563662	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Carbon disulfide	75150	1.00E-01 I	2.00E-01 I			x	1000 N	730 N	140 N	200000 N	7800 N	11 E	14 E
Carbon tetrachloride	56235	7.00E-04 I	5.71E-04 E	1.30E-01 I	5.25E-02 I	x	0.16 C	0.12 C	0.024 C	44 C	4.9 C	0.2 E	0.03 E
Carbosulfan	55285148	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Carboxin	5234684	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Chloral	75876	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Chloramben	133904	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
Chloranil	118752			4.03E-01 H			0.17 C	0.016 C	0.0078 C	14 C	1.6 C		
Chlordane	57749	6.00E-05 I		1.30E+00 I	1.29E+00 I		0.052 C	0.0049 C	0.0024 C	4.4 C	0.49 C	10 E	2 E
Chlorimuron-ethyl	90982324	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Chlorine	7782505	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Chlorine dioxide	10049044		5.71E-05 I				2.1 N	0.21 N					
Chloroacetaldehyde	107200	6.90E-03 O					250 N	25 N	9.3 N	14000 N	540 N		
Chloroacetic acid	79118	2.00E-03 H					73 N	7.3 N	2.7 N	4100 N	160 N		
2-Chloroacetophenone	532274		8.57E-06 I				0.31 N	0.031 N					
4-Chloroaniline	106478	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N	1200 S	0.3 E
Chlorobenzene	108907	2.00E-02 I	5.71E-03 A			x	39 N	21 N	27 N	41000 N	1600 N	94 E	0.6 E
Chlorobenzilate	510156	2.00E-02 I		2.70E-01 H	2.70E-01 H		0.25 C	0.023 C	0.012 C	21 C	2.4 C		
p-Chlorobenzoic acid	74113	2.00E-01 H					7300 N	730 N	270 N	410000 N	16000 N		
4-Chlorobenzotrifluoride	98566	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N	86 N	7.5 N
2-Chloro-1,3-butadiene	126998	2.00E-02 A	2.00E-03 H			x	14 N	7.3 N	27 N	41000 N	1600 N		
1-Chlorobutane	109693	4.00E-01 H				x	2400 N	1500 N	540 N	820000 N	31000 N		
Chlorodibromomethane	124481	2.00E-02 I		8.40E-02 I		x	0.13 C	0.075 C	0.038 C	68 C	7.6 C	1900 E	0.2 E
1-Chloro-1,1-difluoroethane	75683		1.43E+01 I			x	87000 N	52000 N					
Chlorodifluoromethane	75456		1.43e+01 I			x	87000 N	52000 N					
Chloroethane	75003	4.00E-01 E	2.86E+00 I			x	8600 N	10000 N	540 N	820000 N	31000 N	2600 S	33 N
2-Chloroethyl vinyl ether	110758	2.50E-02 O				x	150 N	91 N	34 N	51000 N	2000 N		
Chloroform	67663	1.00E-02 I		6.10E-03 I	8.05E-02 I	x	0.15 C	0.078 C	0.52 C	940 C	100 C	0.2 E	0.3 E
Chloromethane	74873			1.30E-02 H	6.30E-03 H	x	1.4 C	0.99 C	0.24 C	440 C	49 C	0.063 C	0.0066 C
4-Chloro-2,2-methylaniline hydrochloride	3165933			4.60E-01 H			0.15 C	0.014 C	0.0069 C	12 C	1.4 C		
4-Chloro-2-methylaniline	95692			5.80E-01 H			0.12 C	0.011 C	0.0054 C	9.9 C	1.1 C		
beta-Chloronaphthalene	91587	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N	2.8 S	140 N
o-Chloronitrobenzene	88733			2.50E-02 H		x	0.42 C	0.25 C	0.13 C	230 C	26 C		
p-Chloronitrobenzene	100005			1.80E-02 H		x	0.59 C	0.35 C	0.18 C	320 C	35 C		
2-Chlorophenol	95578	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N	53000 E	2 E
2-Chloropropane	75296		2.86E-02 H			x	170 N	100 N				22 N	0.64 N
Chlorothalonil	1897456	1.50E-02 I		1.10E-02 H			6.1 C	0.57 C	0.29 C	520 C	58 C		
o-Chlorotoluene	95498	2.00E-02 I				x	120 N	73 N	27 N	41000 N	1600 N	1200 N	5.6 N
Chlorpropham	101213	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Chlorpyrifos	2921882	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Chlorpyrifos-methyl	5598130	1.00E-02 H					370 N	37 N	14 N	20000 N	780 N		
Chlorsulfuron	64902723	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Chlorthiophos	60238564	8.00E-04 H					29 N	2.9 N	1.1 N	1600 N	63 N		
Chromium III and compounds	16065831	1.00E+00 I	5.71E-07 W				37000 N	0.0021 N	1400 N	1000000 N	78000 N		
Chromium VI and compounds	18540299	5.00E-03 I			4.20E+01 I		180 N	0.00015 C	6.8 N	10000 N	390 N	140 E	19 E

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
										Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC	Tap Water	Ambient Air	Fish	Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Coal tar	8001589				2.20E+00 W			0.0028 C					
Cobalt	7440484	6.00E-02 E					2200 N	220 N	81 N	120000 N	4700 N		
Coke Oven Emissions	8007452				2.17E+00 I			0.0029 C	0	0	0		
Copper and compounds	7440508	4.00E-02 E					1500 N	150 N	54 N	82000 N	3100 N		
Crotonaldehyde	123739	1.00E-02 W		1.90E+00 H	1.90E+00 W		0.035 C	0.0033 C	0.0017 C	3 C	0.34 C		
Cumene	98828	4.00E-02 I	2.57E-03 H				1500 N	9.4 N	54 N	82000 N	3100 N	81 N	65 N
Cyanides:													
Barium cyanide	542621	1.00E-01 W					3700 N	370 N	140 N	200000 N	7800 N		
Calcium cyanide	592018	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
**Chlorine cyanide	506774	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Copper cyanide	544923	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Cyanazine	21725462	2.00E-03 H		8.40E-01 H			0.08 C	0.0075 C	0.0038 C	6.8 C	0.76 C		
Cyanogen	460195	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Cyanogen bromide	506683	9.00E-02 I					3300 N	330 N	120 N	180000 N	7000 N		
Cyanogen chloride	506774	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Free cyanide	57125	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Hydrogen cyanide	74908	2.00E-02 I	8.57E-04 I				730 N	3.1 N	27 N	41000 N	1600 N		
Potassium cyanide	151508	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Potassium silver cyanide	506616	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Silver cyanide	506649	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Sodium cyanide	143339	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Thiocyanate		2.00E-02 E					730 N	73 N	27 N	41000 N	1600 N		
Zinc cyanide	557211	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Cyclohexanone	108941	5.00E+00 I				x	30000 N	18000 N	6800 N	1000000 N	390000 N		
Cyclohexlamine	108918	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Cyhalothrin/Karate	68085858	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Cypermethrin	52315078	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Cyromazine	66215278	7.50E-03 I					270 N	27 N	10 N	15000 N	590 N		
Dacthal	1861321	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Dalapon	75990	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Danitol	39515418	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
DDD	72548			2.40E-01 I			0.28 C	0.026 C	0.013 C	24 C	2.7 C	37 S	0.7 E
DDE	72559			3.40E-01 I			0.2 C	0.018 C	0.0093 C	17 C	1.9 C	10 S	0.5 E
DDT	50293	5.00E-04 I		3.40E-01 I	3.40E-01 I		0.2 C	0.018 C	0.0093 C	17 C	1.9 C	80 E	1 E
Decabromodiphenyl ether	1163195	1.00E-02 I				x	61 N	37 N	14 N	20000 N	780 N		
Demeton	8065483	4.00E-05 I					1.5 N	0.15 N	0.054 N	82 N	3.1 N		
Diallate	2303164			6.10E-02 H		x	0.17 C	0.1 C	0.052 C	94 C	10 C		
Diazinon	333415	9.00E-04 H					33 N	3.3 N	1.2 N	1800 N	70 N	5400 S	2.8 N
Dibenzofuran	132649	4.00E-03 E					150 N	15 N	5.4 N	8200 N	310 N	120 S	120 N
1,4-Dibromobenzene	106376	1.00E-02 I				x	61 N	37 N	14 N	20000 N	780 N		
1,2-Dibromo-3-chloropropane	96128		5.71E-05 I	1.40E+00 H	2.42E-03 H	x	0.048 C	0.21 N	0.0023 C	4.1 C	0.46 C	1.9 N	0.00061 M
1,2-Dibromoethane	106934		5.71E-05 H	8.50E+01 I	7.70E-01 I	x	0.00075 C	0.0081 C	0.000037 C	0.067 C	0.0075 C	0.0058 C	0.00018 M
Dibutyl phthalate	84742	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	100 E	120 E
Dicamba	1918009	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
1,2-Dichlorobenzene	95501	9.00E-02 I	4.00E-02 A			x	270 N	150 N	120 N	180000 N	7000 N	300 E	6 E
1,3-Dichlorobenzene	541731	8.90E-02 O				x	540 N	320 N	120 N	180000 N	7000 N		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Risk-Based Concentrations: Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Soil Ingestion: Industrial mg/kg	Soil Ingestion: Residential mg/kg	Soil Screening Levels - Transfers from Soil to: Air mg/kg	Groundwater mg/kg
1,4-Dichlorobenzene	106467		2.29E-01 I	2.40E-02 H		x	0.44 C	0.26 C	0.13 C	240 C	27 C	7700 E	1 E
3,3'-Dichlorobenzidine	91941			4.50E-01 I			0.15 C	0.014 C	0.007 C	13 C	1.4 C	52 S	0.01 E
1,4-Dichloro-2-butene	764410				9.30E+00 H	x	0.0011 C	0.00067 C					
Dichlorodifluoromethane	75718	2.00E-01 I	5.71E-02 A			x	390 N	210 N	270 N	410000 N	16000 N	37 N	7.5 N
1,1-Dichloroethane	75343	1.00E-01 H	1.43E-01 A			x	810 N	520 N	140 N	200000 N	7800 N	980 E	11 E
1,2-Dichloroethane (EDC)	107062		2.86E-03 E	9.10E-02 I	9.10E-02 I	x	0.12 C	0.069 C	0.035 C	63 C	7 C	0.3 E	0.01 E
1,1-Dichloroethylene	75354	9.00E-03 I		6.00E-01 I	1.75E-01 I	x	0.044 C	0.036 C	0.0053 C	9.5 C	1.1 C	0.04 E	0.03 E
1,2-Dichloroethylene (cis)	156592	1.00E-02 H				x	61 N	37 N	14 N	20000 N	780 N	1500 E	0.2 E
1,2-Dichloroethylene (trans)	156605	2.00E-02 I				x	120 N	73 N	27 N	41000 N	1600 N	3600 E	0.3 E
1,2-Dichloroethylene (mixture)	540590	9.00E-03 H				x	55 N	33 N	12 N	18000 N	700 N		
2,4-Dichlorophenol	120832	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N	4800 S	0.5 E
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94757	1.00E-02 I				x	61 N	37 N	14 N	20000 N	780 N	7000 S	1.7 M
4-(2,4-Dichlorophenoxy)butyric Acid	94826	8.00E-03 I					290 N	29 N	11 N	16000 N	630 N		
1,2-Dichloropropane	78875		1.14E-03 I	6.80E-02 H		x	0.16 C	0.092 C	0.046 C	84 C	9.4 C	11 E	0.02 E
2,3-Dichloropropanol	616239	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
1,3-Dichloropropene	542756	3.00E-04 I	5.71E-03 I	1.75E-01 H	1.30E-01 H	x	0.077 C	0.048 C	0.018 C	33 C	3.7 C	0.1 E	0.001 E
Dichlorvos	62737	5.00e-04 I	1.43E-04 I	2.90E-01 I			0.23 C	0.022 C	0.011 C	20 C	2.2 C	3.5 C	0.00072 C
Dicofol	115322			4.40E-01 W			0.15 C	0.014 C	0.0072 C	13 C	1.5 C		
Dicyclopentadiene	77736	3.00E-02 H	5.71E-05 A			x	0.42 N	0.21 N	41 N	61000 N	2300 N		
Dieldrin	60571	5.00E-05 I		1.60E+01 I	1.61E+01 I		0.0042 C	0.00039 C	0.0002 C	0.36 C	0.04 C	2 E	0.001 E
Diesel emissions			1.43E-03 I				52 N	5.2 N					
Diethyl phthalate	84662	8.00E-01 I					29000 N	2900 N	1100 N	1000000 N	63000 N	520 E	110 E
Diethylene glycol, monobutyl ether	112345		5.71E-03 H				210 N	21 N					
Diethylene glycol, monoethyl ether	111900	2.00E+00 H					73000 N	7300 N	2700 N	1000000 N	160000 N		
Diethylforamide	617845	1.10E-02 H					400 N	40 N	15 N	22000 N	860 N		
Di(2-ethylhexyl)adipate	103231	6.00E-01 I		1.20E-03 I			56 C	5.2 C	2.6 C	4800 C	530 C		
Diethylstilbestrol	56531			4.70E+03 H			0.000014 C	0.0000013 C	7E-07 C	0.0012 C	0.00014 C		
Difenzoquat (Avenge)	43222486	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Diflubenzuron	35367385	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
1,1-Difluoroethane	75376		1.14E+01 I			x	69000 N	42000 N					
Diisopropyl methylphosphonate (DIMP)	1445756	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Dimethipin	55290647	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Dimethoate	60515	2.00E-04 I					7.3 N	0.73 N	0.27 N	410 N	16 N		
3,3'-Dimethoxybenzidine	119904			1.40E-02 H			4.8 C	0.45 C	0.23 C	410 C	46 C		
Dimethylamine	124403		5.71E-06 W				0.21 N	0.021 N					
2,4-Dimethylaniline hydrochloride	21436964			5.80E-01 H			0.12 C	0.011 C	0.0054 C	9.9 C	1.1 C		
2,4-Dimethylaniline	95681			7.50E-01 H			0.09 C	0.0083 C	0.0042 C	7.6 C	0.85 C		
N-N-Dimethylaniline	121697	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
3,3'-Dimethylbenzidine	119937			9.20E+00 H			0.0073 C	0.00068 C	0.00034 C	0.62 C	0.069 C	29 C	0.00039 C
N,N-Dimethylformamide	68122	1.00E-01 H	8.57E-03 I				3700 N	31 N	140 N	200000 N	7800 N		
1,1-Dimethylhydrazine	57147			2.60E+00 W	3.50E+00 W		0.026 C	0.0018 C	0.0012 C	2.2 C	0.25 C		
1,2-Dimethylhydrazine	540738			3.70E+01 W	3.70E+01 W		0.0018 C	0.00017 C	0.000085 C	0.15 C	0.017 C		
2,4-Dimethylphenol	105679	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N	5400 S	3 E
2,6-Dimethylphenol	576261	6.00E-04 I					22 N	2.2 N	0.81 N	1200 N	47 N		
3,4-Dimethylphenol	95658	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Dimethyl phthalate	131113	1.00E+01 H					370000 N	37000 N	14000 N	1000000 N	780000 N	1600 E	1200 E

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels Transfers from Soil to:	
										Soil Ingestion			
Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Industrial mg/kg	Residential mg/kg	Air mg/kg	Groundwater mg/kg
Dimethyl terephthalate	120616	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
1,2-Dinitrobenzene	528290	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
1,3-Dinitrobenzene	99650	1.00E-04 I					3.7 N	0.37 N	0.14 N	200 N	7.8 N		
1,4-Dinitrobenzene	100254	4.00E-04 H					15 N	1.5 N	0.54 N	820 N	31 N		
4,6-Dinitro-o-cyclohexyl phenol	131895	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
2,4-Dinitrophenol	51285	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N	360 N	0.1 E
Dinitrotoluene mixture				6.80E-01 I			0.099 C	0.0092 C	0.0046 C	8.4 C	0.94 C		
2,4-Dinitrotoluene	121142	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N	120 S	0.2 E
2,6-Dinitrotoluene	606202	1.00E-03 H					37 N	3.7 N	1.4 N	2000 N	78 N	370 S	0.1 E
Dinoseb	88857	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
di-n-Octyl phthalate	117840	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N	1000000 S	1000000 E
1,4-Dioxane	123911			1.10E-02 I			6.1 C	0.57 C	0.29 C	520 C	58 C		
Diphenamid	957517	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Diphenylamine	122394	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
1,2-Diphenylhydrazine	122667			8.00E-01 I	7.70E-01 I		0.084 C	0.0081 C	0.0039 C	7.2 C	0.8 C		
Diquat	85007	2.20E-03 I					80 N	8 N	3 N	4500 N	170 N		
Direct black 38	1937377			8.60E+00 H			0.0078 C	0.00073 C	0.00037 C	0.67 C	0.074 C		
Direct blue 6	2602462			8.10E+00 H			0.0083 C	0.00077 C	0.00039 C	0.71 C	0.079 C		
Direct brown 95	16071866			9.30E+00 H			0.0072 C	0.00067 C	0.00034 C	0.62 C	0.069 C		
Disulfoton	298044	4.00E-05 I					1.5 N	0.15 N	0.054 N	82 N	3.1 N		
1,4-Dithiane	505293	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Diuron	330541	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Dodine	2439103	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Endosulfan	115297	6.00E-03 I					220 N	22 N	8.1 N	12000 N	470 N	1 S	3 E
Endothall	145733	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Endrin	72208	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N	16 S	0.4 E
Epichlorohydrin	106898	2.00E-03 H	2.86E-04 I	9.90E-03 I	4.20E-03 I		6.8 C	1 N	0.32 C	580 C	65 C		
1,2-Epoxybutane	106887		5.71E-03 I				210 N	21 N					
Ethephon (2-chloroethyl phosphonic acid)	16672870	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Ethion	563122	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
2-Ethoxyethanol acetate	111159	3.00E-01 A					11000 N	1100 N	410 N	610000 N	23000 N		
2-Ethoxyethanol	110805	4.00E-01 H	5.71E-02 I				15000 N	210 N	540 N	820000 N	31000 N		
Ethyl acrylate	140885			4.80E-02 H			1.4 C	0.13 C	0.066 C	120 C	13 C		
EPTC (S-Ethyl dipropylthiocarbamate)	759944	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Ethyl acetate	141786	9.00E-01 I					33000 N	3300 N	1200 N	1000000 N	70000 N		
Ethylbenzene	100414	1.00E-01 I	2.86E-01 I			x	1300 N	1000 N	140 N	200000 N	7800 N	260 E	5 E
Ethylene cyanohydrin	109784	3.00E-01 H					11000 N	1100 N	410 N	610000 N	23000 N		
Ethylene diamine	107153	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N		
Ethylene glycol	107211	2.00E+00 I					73000 N	7300 N	2700 N	1000000 N	160000 N		
Ethylene glycol, monobutyl ether	111762		5.71E-03 H				210 N	21 N					
Ethylene oxide	75218			1.02E+00 H	3.50E-01 H		0.066 C	0.018 C	0.0031 C	5.6 C	0.63 C		
Ethylene thiourea (ETU)	96457	8.00E-05 I		1.19E-01 H			0.57 C	0.053 C	0.027 C	48 C	5.4 C		
Ethyl ether	60297	2.00E-01 I				x	1200 N	730 N	270 N	410000 N	16000 N		
Ethyl methacrylate	97632	9.00E-02 H					3300 N	330 N	120 N	180000 N	7000 N		
Ethyl p-nitrophenyl phenylphosphorothioate	2104645	1.00E-05 I					0.37 N	0.037 N	0.014 N	20 N	0.78 N		
Ethylnitrosourea	759739			1.40E+02 W			0.00048 C	0.000045 C	0.000023 C	0.041 C	0.0046 C		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels: Transfers from Soil to:	
							Tap Water	Ambient Air	Fish	Soil Ingestion			
Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	µg/L	µg/m3	mg/kg	Industrial mg/kg	Residential mg/kg	Air mg/kg	Groundwater mg/kg
Ethylphthalyl ethyl glycolate	84720	3.00E+00 I					110000 N	11000 N	4100 N	1000000 N	230000 N		
Express	10120	8.00E-03 I					290 N	29 N	11 N	16000 N	630 N		
Fenamiphos	22224926	2.50E-04 I					9.1 N	0.91 N	0.34 N	510 N	20 N		
Fluometuron	2164172	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Fluoride	7782414	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N		
Fluoridone	59756604	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Flurprimidol	56425913	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Flutolanil	66332965	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N		
Fluvalinate	69409945	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Folpet	133073	1.00E-01 I		3.50E-03 I			19 C	1.8 C	0.9 C	1600 C	180 C		
Fomesafen	72178020			1.90E-01 I			0.35 C	0.033 C	0.017 C	30 C	3.4 C		
Fonofos	944229	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Formaldehyde	50000	2.00E-01 I			4.55E-02 I		7300 N	0.14 C	270 N	410000 N	16000 N		
Formic Acid	64186	2.00E+00 H					73000 N	7300 N	2700 N	1000000 N	160000 N		
Fosetyl-al	39148248	3.00E+00 I					110000 N	11000 N	4100 N	1000000 N	230000 N		
Furan	110009	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Furazolidone	67458			3.80E+00 H			0.018 C	0.0016 C	0.00083 C	1.5 C	0.17 C		
Furfural	98011	3.00E-03 I	1.43E-02 A				110 N	52 N	4.1 N	6100 N	230 N		
Furium	531828			5.00E+01 H			0.0013 C	0.00013 C	0.000063 C	0.11 C	0.013 C		
Furmecyclox	60568050			3.00E-02 I			2.2 C	0.21 C	0.11 C	190 C	21 C		
Glufosinate-ammonium	77182822	4.00E-04 I					15 N	1.5 N	0.54 N	820 N	31 N		
Glycidaldehyde	765344	4.00E-04 I	2.86E-04 H				15 N	1 N	0.54 N	820 N	31 N		
Glyphosate	1071836	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Haloxyfop-methyl	69806402	5.00E-05 I					1.8 N	0.18 N	0.068 N	100 N	3.9 N		
Harmony	79277273	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
HCH (alpha)	319846			6.30E+00 I	6.30E+00 I		0.011 C	0.00099 C	0.0005 C	0.91 C	0.1 C	0.9 E	0.0004 E
HCH (beta)	319857			1.80E+00 I	1.80E+00 I		0.037 C	0.0035 C	0.0018 C	3.2 C	0.35 C	16 E	0.002 E
HCH (gamma) Lindane	58899	3.00E-04 I		1.30E+00 H			0.052 C	0.0048 C	0.0024 C	4.4 C	0.49 C	4.2 C	0.006 E
HCH-technical	608731			1.80E+00 I	1.79E+00 I		0.037 C	0.0035 C	0.0018 C	3.2 C	0.35 C		
Heptachlor	76448	5.00E-04 I		4.50E+00 I	4.55E+00 I	x	0.0023 C	0.0014 C	0.0007 C	1.3 C	0.14 C	0.3 E	0.06 E
Heptachlor epoxide	1024573	1.30E-05 I		9.10E+00 I	9.10E+00 I	x	0.0012 C	0.00069 C	0.00035 C	0.63 C	0.07 C	1 E	0.03 E
Hexabromobenzene	87821	2.00E-03 I				x	12 N	7.3 N	2.7 N	4100 N	160 N		
Hexachlorobenzene	118741	8.00E-04 I		1.60E+00 I	1.61E+00 I	x	0.0066 C	0.0039 C	0.002 C	3.6 C	0.4 C	1 E	0.8 E
Hexachlorobutadiene	87683	2.00E-04 H		7.80E-02 I	7.70E-02 I	x	0.14 C	0.081 C	0.04 C	73 C	8.2 C	1 E	0.1 E
Hexachlorocyclopentadiene	77474	7.00E-03 I	2.00E-05 H			x	0.15 N	0.073 N	9.5 N	14000 N	550 N	2 E	10 E
Hexachlorodibenzo-p-dioxin mixture	19408743			6.20E+03 I	4.55E+03 I		0.000011 C	0.0000014 C	5E-07 C	0.00092 C	0.0001 C		
Hexachloroethane	67721	1.00E-03 I		1.40E-02 I	1.40E-02 I	x	0.75 C	0.45 C	0.23 C	410 C	46 C	49 E	0.2 E
Hexachlorophene	70304	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121824	3.00E-03 I		1.10E-01 I			0.61 C	0.057 C	0.029 C	52 C	5.8 C		
1,6-Hexamethylene diisocyanate	822060		2.86E-06 I				0.1 N	0.01 N					
n-Hexane	110543	6.00E-02 H	5.71E-02 I			x	350 N	210 N	81 N	120000 N	4700 N	32 N	13 N
Hexazinone	51235042	3.30E-02 I					1200 N	120 N	45 N	67000 N	2600 N		
Hydrazine, hydrazine sulfate	302012			3.00E+00 I	1.71E+01 I		0.022 C	0.00037 C	0.0011 C	1.9 C	0.21 C		
Hydrogen chloride	7647010		5.71E-03 I				210 N	21 N					
Hydrogen sulfide	7783064	3.00E-03 I	2.85E-04 I				110 N	1 N	4.1 N	6100 N	230 N		
Hydroquinone	123319	4.00E-02 H					1500 N	150 N	54 N	82000 N	3100 N		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis : C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
										Soil Ingestion			
Contaminant	CAS	RfDo mg/kg/d	RfDi mg/kg/d	CPSo kg·d/mg	CPSi kg·d/mg	VOC	Tap Water µg/L	Ambient Air µg/m3	Fish mg/kg	Industrial mg/kg	Residential mg/kg	Air mg/kg	Groundwater mg/kg
Imazalil	35554440	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Imazaquin	81335377	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Iprodione	36734197	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Iron	7439896	3.00E-01 E					11000 N	1100 N	410 N	610000 N	23000 N		
Isobutanol	78831	3.00E-01 I				x	1800 N	1100 N	410 N	610000 N	23000 N		
Isophorone	78591	2.00E-01 I		9.50E-04 I			71 C	6.6 C	3.3 C	6000 C	670 C	3400 E	0.2 E
Isopropalin	33820530	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
Isopropyl methyl phosphonic acid	1832548	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Isoxaben	82558507	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Kepone	143500			1.80E+01 E			0.0037 C	0.00035 C	0.00018 C	0.32 C	0.035 C		
Lactofen	77501634	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Linuron	330552	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Lithium	7439932	2.00E-02 E					730 N	73 N	27 N	41000 N	1600 N		
Londax	83056996	2.00E-01 I					7300 N	730 N	270 N	410000 N	16000 N		
Malathion	121755	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Maleic anhydride	108316	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Maleic hydrazide	123331	5.00E-01 I					18000 N	1800 N	680 N	1000000 N	39000 N		
Malononitrile	109773	2.00E-05 H					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Mancozeb	8018017	3.00E-02 H					1100 N	110 N	41 N	61000 N	2300 N		
Maneb	12427382	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
**Manganese and compounds	7439965	2.30E-02 I	1.43e-05 I				840 N	0.052 N	31 N	47000 N	1800 N		
Mephosfolan	950107	9.00E-05 H					3.3 N	0.33 N	0.12 N	180 N	7 N		
Mepiquat chloride	24307264	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Mercuric chloride	7487947	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Mercury (inorganic)	7439976	3.00E-04 H	8.57E-05 H				11 N	0.31 N	0.41 N	610 N	23 N	7 E	3 E
Mercury (methyl)	22967926	1.00E-04 I					3.7 N	0.37 N	0.14 N	200 N	7.8 N		
Merphos	150505	3.00E-05 I					1.1 N	0.11 N	0.041 N	61 N	2.3 N		
Merphos oxide	78488	3.00E-05 I					1.1 N	0.11 N	0.041 N	61 N	2.3 N		
Metalaxyl	57837191	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N		
Methacrylonitrile	126987	1.00E-04 I	2.00E-04 A				3.7 N	0.73 N	0.14 N	200 N	7.8 N		
Methamidophos	10265926	5.00E-05 I					1.8 N	0.18 N	0.068 N	100 N	3.9 N		
Methanol	67561	5.00E-01 I					18000 N	1800 N	680 N	1000000 N	39000 N		
Methidathion	950378	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Methomyl	16752775	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Methoxychlor	72435	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N	41 S	62 E
2-Methoxyethanol acetate	110496	2.00E-03 A					73 N	7.3 N	2.7 N	4100 N	160 N		
2-Methoxyethanol	109864	1.00E-03 H	5.71E-03 I				37 N	21 N	1.4 N	2000 N	78 N		
2-Methoxy-5-nitroaniline	99592			4.60E-02 H			1.5 C	0.14 C	0.069 C	120 C	14 C		
Methyl acetate	79209	1.00E+00 H					37000 N	3700 N	1400 N	1000000 N	78000 N		
Methyl acrylate	96333	3.00E-02 A					1100 N	110 N	41 N	61000 N	2300 N		
2-Methylaniline hydrochloride	636215			1.80E-01 H			0.37 C	0.035 C	0.018 C	32 C	3.5 C		
2-Methylaniline	95534			2.40E-01 H			0.28 C	0.026 C	0.013 C	24 C	2.7 C		
Methyl chlorocarbonate	79221	1.00E+00 W					37000 N	3700 N	1400 N	1000000 N	78000 N		
4-(2-Methyl-4-chlorophenoxy) butyric acid	94815	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
2-Methyl-4-chlorophenoxyacetic acid	94746	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
2-(2-Methyl-14-chlorophenoxy)propionic acid	93652	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		

Sources: *I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.*

Basis: *C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.*

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
										Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC	Tap Water	Ambient Air	Fish	Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Methylcyclohexane	108872		8.57E-01 H				31000 N	3100 N				60 S	1500 N
Methylene bromide	74953	1.00E-02 A				x	61 N	37 N	14 N	20000 N	780 N		
Methylene chloride	75092	6.00E-02 I	8.57E-01 H	7.50E-03 I	1.64E-03 I	x	4.1 C	3.8 C	0.42 C	760 C	85 C	7 E	0.01 E
4,4'-Methylene bis(2-chloroaniline)	101144	7.00E-04 H		1.30E-01 H	1.30E-01 H		0.52 C	0.048 C	0.024 C	44 C	4.9 C		
4,4'-Methylenebisbenzeneamine	101779			2.50E-01 W			0.27 C	0.025 C	0.013 C	23 C	2.6 C		
4,4'-Methylene bis(N,N'-dimethyl)aniline	101611			4.60E-02 I			1.5 C	0.14 C	0.069 C	120 C	14 C		
4,4'-Methylenediphenyl isocyanate	101688		5.71E-06 I			x	0.035 N	0.021 N					
Methyl ethyl ketone	78933	6.00E-01 I	2.86E-01 I			x	1900 N	1000 N	810 N	1000000 N	47000 N		
Methyl hydrazine	60344			1.10E+00 W			0.061 C	0.0057 C	0.0029 C	5.2 C	0.58 C		
Methyl isobutyl ketone	108101	8.00E-02 H	2.29E-02 A				2900 N	84 N	110 N	160000 N	6300 N		
Methyl methacrylate	80626	8.00E-02 H					2900 N	290 N	110 N	160000 N	6300 N		
2-Methyl-5-nitroaniline	99558			3.30E-02 H			2 C	0.19 C	0.096 C	170 C	19 C		
Methyl parathion	298000	2.50E-04 I					9.1 N	0.91 N	0.34 N	510 N	20 N	28 S	0.041 N
2-Methylphenol (o-cresol)	95487	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N	12000 S	6 E
3-Methylphenol (m-cresol)	103394	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
4-Methylphenol (p-cresol)	106445	5.00E-03 H					180 N	18 N	6.8 N	10000 N	390 N		
Methyl styrene (mixture)	25013154	6.00E-03 A	1.14E-02 A			x	60 N	42 N	8.1 N	12000 N	470 N	100 N	1 N
Methyl styrene (alpha)	98839	7.00E-02 A				x	430 N	260 N	95 N	140000 N	5500 N	8.8 S	7.5 N
Methyl tertbutyl ether (MTBE)	1634044	5.00E-03 E	8.57E-01 I			x	180 N	3100 N	6.8 N	10000 N	390 N		
Metolaclor (Dual)	51218452	1.50E-01 H					5500 N	550 N	200 N	310000 N	12000 N		
Metribuzin	21087649	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Mirex	2385855	2.00E-04 I		1.80E+00 W			0.037 C	0.0035 C	0.0018 C	3.2 C	0.35 C		
Molinate	2212671	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Molybdenum	7439987	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Monochloramine	10599903	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Naled	300765	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
2-Naphthylamine	91598			1.30e+02 E			0.00052 C	0.000048 C	0.000024 C	0.044 C	0.0049 C		
Napropamide	15299997	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
Nickel refinery dust					8.40E-01 I		0	0.0075 C					
Nickel and compounds	7440020	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N	6900 E	21 E
Nickel subsulfide	12035722				1.70E+00 I		0	0.0037 C					
Nitrapyrin	1929824	1.50E-03 W					55 N	5.5 N	2 N	3100 N	120 N		
Nitrate	14797558	1.60E+00 I					58000 N	5800 N	2200 N	1000000 N	130000 N		
Nitric oxide	10102439	1.00E-01 W					3700 N	370 N	140 N	200000 N	7800 N		
Nitrite	14797650	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
2-Nitroaniline	88744	6.00E-05 W	5.71E-05 H				2.2 N	0.21 N	0.081 N	120 N	4.7 N		
3-Nitroaniline	99092	3.00E-03 O					110 N	11 N	4.1 N	6100 N	230 N		
4-Nitroaniline	100016	3.00E-03 O					110 N	11 N	4.1 N	6100 N	230 N		
Nitrobenzene	98953	5.00E-04 I	5.71E-04 A			x	3.4 N	2.1 N	0.68 N	1000 N	39 N	110 E	0.09 E
Nitrofurantoin	67209	7.00E-02 H					2600 N	260 N	95 N	140000 N	5500 N		
Nitrofurazone	59870			1.50E+00 H	9.40E+00 H		0.045 C	0.00067 C	0.0021 C	3.8 C	0.43 C		
Nitrogen dioxide	10102440	1.00E+00 W					37000 N	3700 N	1400 N	1000000 N	78000 N		
Nitroguanidine	556887	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N		
4-Nitrophenol	100027	6.20E-02 O					2300 N	230 N	84 N	130000 N	4800 N		
2-Nitropropane	79469		5.71E-03 I		9.40E+00 H		210 N	0.00067 C					
N-Nitrosodi-n-butylamine	924163			5.40E+00 I	5.60E+00 I		0.012 C	0.0011 C	0.00058 C	1.1 C	0.12 C		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
							Tap Water	Ambient Air	Fish	Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC				Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
N-Nitrosodiethanolamine	1116547			2.80E+00 I			0.024 C	0.0022 C	0.0011 C	2 C	0.23 C		
N-Nitrosodiethylamine	55185			1.50E+02 I	1.51E+02 I		0.00045 C	0.000041 C	0.000021 C	0.038 C	0.0043 C		
N-Nitrosodimethylamine	62759			5.10E+01 I	4.90E+01 I		0.0013 C	0.00013 C	0.000062 C	0.11 C	0.013 C		
N-Nitrosodiphenylamine	86306			4.90E-03 I			14 C	1.3 C	0.64 C	1200 C	130 C	29 C	0.2 E
N-Nitroso di-n-propylamine	621647			7.00E+00 I			0.0096 C	0.00089 C	0.00045 C	0.82 C	0.091 C	0.014 C	0.00002 E
N-Nitroso-N-methylethylamine	10595956			2.20E+01 I			0.0031 C	0.00028 C	0.00014 C	0.26 C	0.029 C		
N-Nitrosopyrrolidine	930552			2.10E+00 I	2.13E+00 I		0.032 C	0.0029 C	0.0015 C	2.7 C	0.3 C		
m-Nitrotoluene	99081	1.00E-02 H				x	61 N	37 N	14 N	20000 N	780 N	460 S	0.42 N
o-Nitrotoluene	88722	1.00E-02 H				x	61 N	37 N	14 N	20000 N	780 N	460 S	0.42 N
p-Nitrotoluene	99990	1.00E-02 H				x	61 N	37 N	14 N	20000 N	780 N	460 S	0.42 N
Norflurazon	27314132	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
NuStar	85509199	7.00E-04 I					26 N	2.6 N	0.95 N	1400 N	55 N		
Octabromodiphenyl ether	32536520	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Octahydro-1357-tetranitro-1357-tetrazocine	2691410	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Octamethylpyrophosphoramide	152169	2.00E-03 H					73 N	7.3 N	2.7 N	4100 N	160 N		
Oryzalin	19044883	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Oxadiazon	19666309	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Oxamyl	23135220	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Oxyfluorfen	42874033	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Paclobutrazol	76738620	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Paraquat	1910425	4.50E-03 I					160 N	16 N	6.1 N	9200 N	350 N		
Parathion	56382	6.00E-03 H					220 N	22 N	8.1 N	12000 N	470 N	110 S	3.9 N
Pebulate	1114712	5.00E-02 H					1800 N	180 N	68 N	100000 N	3900 N		
Pendimethalin	40487421	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N		
Pentabromo-6-chloro cyclohexane	87843			2.30E-02 H			2.9 C	0.27 C	0.14 C	250 C	28 C		
Pentabromodiphenyl ether	32534819	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Pentachlorobenzene	608935	8.00E-04 I				x	4.9 N	2.9 N	1.1 N	1600 N	63 N	570 N	48 N
Pentachloronitrobenzene	82688	3.00E-03 I		2.60E-01 H		x	0.041 C	0.024 C	0.012 C	22 C	2.5 C		
Pentachlorophenol	87865	3.00E-02 I		1.20E-01 I			0.56 C	0.052 C	0.026 C	48 C	5.3 C	7.9 C	0.2 E
Permethrin	52645531	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		
Phenmedipham	13684634	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Phenol	108952	6.00E-01 I					22000 N	2200 N	810 N	1000000 N	47000 N	21000 S	49 E
m-Phenylenediamine	108452	6.00E-03 I					220 N	22 N	8.1 N	12000 N	470 N		
p-Phenylenediamine	106503	1.90E-01 H					6900 N	690 N	260 N	390000 N	15000 N		
Phenylmercuric acetate	62384	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
2-Phenylphenol	90437			1.94E-03 H			35 C	3.2 C	1.6 C	3000 C	330 C		
Phorate	298022	2.00E-04 H					7.3 N	0.73 N	0.27 N	410 N	16 N		
Phosmet	732116	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Phosphine	7803512	3.00E-04 I	8.57E-05 I				11 N	0.31 N	0.41 N	610 N	23 N		
Phosphoric acid	7664382		2.86E-03 I				100 N	10 N					
Phosphorus (white)	7723140	2.00E-05 I					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
p-Phthalic acid	100210	1.00E+00 H					37000 N	3700 N	1400 N	1000000 N	78000 N		
Phthalic anhydride	85449	2.00E+00 I	3.43E-02 H				73000 N	130 N	2700 N	1000000 N	160000 N		
Picloram	1918021	7.00E-02 I					2600 N	260 N	95 N	140000 N	5500 N		
Pirimiphos-methyl	29232937	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
Polybrominated biphenyls		7.00E-06 H		8.90E+00 H			0.0076 C	0.0007 C	0.00035 C	0.64 C	0.072 C		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis: C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
							Tap Water	Ambient Air	Fish	Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC				Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Polychlorinated biphenyls (PCBs)	1336363			7.70E+00 I			0.0087 C	0.00081 C	0.00041 C	0.74 C	0.083 C		
Aroclor 1016	12674112	7.00E-05 I					2.6 N	0.26 N	0.095 N	140 N	5.5 N		
Aroclor 1254	11097691	2.00E-05 I					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Polychlorinated terphenyls (PCTs)				4.50E+00 E			0.015 C	0.0014 C	0.0007 C	1.3 C	0.14 C		
Polynuclear aromatic hydrocarbons												110000 S	
Acenaphthene	83329	6.00E-02 I					2200 N	220 N	81 N	120000 N	4700 N	120 S	200 E
Anthracene	120127	3.00E-01 I					11000 N	1100 N	410 N	610000 N	23000 N	6.8 S	4300 E
Benz[a]anthracene	56553			7.30E-01 E	6.10E-01 E		0.092 C	0.01 C	0.0043 C	7.8 C	0.88 C	27 S	0.7 E
Benzo[b]fluoranthene	205992			7.30E-01 E	6.10E-01 E		0.092 C	0.01 C	0.0043 C	7.8 C	0.88 C	23 S	4 E
Benzo[k]fluoranthene	207089			7.30E-02 E	6.10E-02 E		0.92 C	0.1 C	0.043 C	78 C	8.8 C		4 E
Benzo[a]pyrene	50328			7.30E+00 I	6.10E+00 W		0.0092 C	0.001 C	0.00043 C	0.78 C	0.088 C	11 S	4 E
Carbazole	86748			2.00E-02 H			3.4 C	0.31 C	0.16 C	290 C	32 C	11 S	0.5 E
Chrysene	218019			7.30E-03 E	6.10E-03 E		9.2 C	1 C	0.43 C	780 C	88 C	3.6 S	1 E
Dibenz[ah]anthracene	53703			7.30E+00 E	6.10E+00 E		0.0092 C	0.001 C	0.00043 C	0.78 C	0.088 C	7.2 S	11 E
Fluoranthene	206440	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N	68 S	980 E
Fluorene	86737	4.00E-02 I					1500 N	150 N	54 N	82000 N	3100 N	89 S	160 E
Indeno[1,2,3-cd]pyrene	193395			7.30E-01 E	6.10E-01 E		0.092 C	0.01 C	0.0043 C	7.8 C	0.88 C	280 S	35 E
Naphthalene	91203	4.00E-02 W					1500 N	150 N	54 N	82000 N	3100 N	180 S	30 E
Pyrene	129000	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N	56 S	1400 E
Prochloraz	67747095	9.00E-03 I		1.50E-01 I			0.45 C	0.042 C	0.021 C	38 C	4.3 C		
Profluralin	26399360	6.00E-03 H					220 N	22 N	8.1 N	12000 N	470 N		
Prometon	1610180	1.50E-02 I					550 N	55 N	20 N	31000 N	1200 N		
Prometryn	7287196	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Pronamide	23950585	7.50E-02 I					2700 N	270 N	100 N	150000 N	5900 N		
Propachlor	1918167	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Propanil	709988	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Propargite	2312358	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Propargyl alcohol	107197	2.00E-03 I					73 N	7.3 N	2.7 N	4100 N	160 N		
Propazine	139402	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Propham	122429	2.00E-02 I					730 N	73 N	27 N	41000 N	1600 N		
Propiconazole	60207901	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Propylene glycol	57556	2.00E+01 H					730000 N	73000 N	27000 N	1000000 N	1000000 N		
Propylene glycol, monoethyl ether	52125538	7.00E-01 H					26000 N	2600 N	950 N	1000000 N	55000 N		
Propylene glycol, monomethyl ether	107982	7.00E-01 H	5.71E-01 I				26000 N	2100 N	950 N	1000000 N	55000 N		
Propylene oxide	75569		8.57E-03 I	2.40E-01 I	1.29E-02 I		0.28 C	0.49 C	0.013 C	24 C	2.7 C		
Pursuit	81335775	2.50E-01 I					9100 N	910 N	340 N	510000 N	20000 N		
Pydrin	51630581	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Pyridine	110861	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Quinalphos	13593038	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
Quinoline	91225			1.20E+01 H			0.0056 C	0.00052 C	0.00026 C	0.48 C	0.053 C		
Resmethrin	10463868	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
Ronnel	299843	5.00E-02 H					1800 N	180 N	68 N	100000 N	3900 N		
Rotenone	83794	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Savey	78587050	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Selenious Acid	7783008	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Selenium	7782492	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		3 E

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST
E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis : C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level
S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels- Transfers from Soil to:	
						V	Tap	Ambient		Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	O	Water	Air	Fish	Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg	C	µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Selenourea	630104	5.00E-03 H					180 N	18 N	6.8 N	10000 N	390 N		
Sethoxydim	74051802	9.00E-02 I					3300 N	330 N	120 N	180000 N	7000 N		
Silver and compounds	7440224	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Simazine	122349	5.00E-03 I		1.20E-01 H			0.56 C	0.052 C	0.026 C	48 C	5.3 C		
Sodium azide	26628228	4.00E-03 I					150 N	15 N	5.4 N	8200 N	310 N		
Sodium diethyldithiocarbamate	148185	3.00E-02 I		2.70E-01 H			0.25 C	0.023 C	0.012 C	21 C	2.4 C		
Sodium fluoroacetate	62748	2.00E-05 I					0.73 N	0.073 N	0.027 N	41 N	1.6 N		
Sodium metavanadate	13718268	1.00E-03 H					37 N	3.7 N	1.4 N	2000 N	78 N		
Strontium, stable	7440246	6.00E-01 I					22000 N	2200 N	810 N	1000000 N	47000 N		
Strychnine	57249	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Styrene	100425	2.00E-01 I	2.86E-01 I			x	1600 N	1000 N	270 N	410000 N	16000 N	1400 E	2 E
Systhane	88671890	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
2,3,7,8-TCDD (dioxin)	1746016			1.56E+05 H	1.16E+05 H		4.3E-07 C	5.4E-08 C		0.000037 C	4.1E-06 C		
Tebuthiuron	34014181	7.00E-02 I					2600 N	260 N	95 N	140000 N	5500 N		
Temephos	3383968	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N		
Terbacil	5902512	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Terbufos	13071799	2.50E-05 H					0.91 N	0.091 N	0.034 N	51 N	2 N		
Terbutryn	886500	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
1,2,4,5-Tetrachlorobenzene	95943	3.00E-04 I				x	1.8 N	1.1 N	0.41 N	610 N	23 N	91 N	0.69 N
1,1,1,2-Tetrachloroethane	630206	3.00E-02 I		2.60E-02 I	2.59E-02 I	x	0.41 C	0.24 C	0.12 C	220 C	25 C		
1,1,2,2-Tetrachloroethane	79345			2.00E-01 I	2.03E-01 I	x	0.052 C	0.031 C	0.016 C	29 C	3.2 C	0.4 E	0.001 E
Tetrachloroethylene (PCE)	127184	1.00E-02 I		5.20E-02 E	2.03E-03 E	x	1.1 C	3.1 C	0.061 C	110 C	12 C	11 E	0.04 E
2,3,4,6-Tetrachlorophenol	58902	3.00E-02 I					1100 N	110 N	41 N	61000 N	2300 N		
p,a,a,a-Tetrachlorotoluene	5216251			2.00E+01 H		x	0.00053 C	0.00031 C	0.00016 C	0.29 C	0.032 C		
Tetrachlorovinphos	961115	3.00E-02 I		2.40E-02 H			2.8 C	0.26 C	0.13 C	240 C	27 C		
Tetraethyldithiopyrophosphate	3689245	5.00E-04 I					18 N	1.8 N	0.68 N	1000 N	39 N		
Tetraethyl lead	78002	1.00E-07 I					0.0037 N	0.00037 N	0.00014 N	0.2 N	0.0078 N	0.00068 N	0.000034 N
1,1,1,2-Tetrafluoroethane	811972	I	2.29E+01			x	140000 N	84000 N					
Thallic oxide	1314325	7.00E-05 W					2.6 N	0.26 N	0.095 N	140 N	5.5 N		
Thallium													0.4 E
Thallium acetate	563688	9.00E-05 I					3.3 N	0.33 N	0.12 N	180 N	7 N		
Thallium carbonate	6533739	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
Thallium chloride	7791120	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
Thallium nitrate	10102451	9.00E-05 I					3.3 N	0.33 N	0.12 N	180 N	7 N		
Thallium selenite	12039520	9.00E-05 W					3.3 N	0.33 N	0.12 N	180 N	7 N		
Thallium sulfate	7446186	8.00E-05 I					2.9 N	0.29 N	0.11 N	160 N	6.3 N		
Thiobencarb	28249776	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
2-(Thiocyanomethylthio)-benzothiazole	21564170	3.00E-02 H					1100 N	110 N	41 N	61000 N	2300 N		
Thiofanox	39196184	3.00E-04 H					11 N	1.1 N	0.41 N	610 N	23 N		
Thiophanate-methyl	23564058	8.00E-02 I					2900 N	290 N	110 N	160000 N	6300 N		
Thiram	137268	5.00E-03 I					180 N	18 N	6.8 N	10000 N	390 N		
Tin and compounds		6.00E-01 H					22000 N	2200 N	810 N	1000000 N	47000 N		
Toluene	108883	2.00E-01 I	1.14E-01 I			x	750 N	420 N	270 N	410000 N	16000 N	520 E	5 E
Toluene-2,4-diamine	95807			3.20E+00 H			0.021 C	0.002 C	0.00099 C	1.8 C	0.2 C		
Toluene-2,5-diamine	95705	6.00E-01 H					22000 N	2200 N	810 N	1000000 N	47000 N		
Toluene-2,6-diamine	823405	2.00E-01 H					7300 N	730 N	270 N	410000 N	16000 N		

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis : C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels- Transfers from Soil to:	
							Tap Water	Ambient Air	Fish	Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC				Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
p-Toluidine	106490			1.90E-01 H			0.35 C	0.033 C	0.017 C	30 C	3.4 C		
Toxaphene	8001352			1.10E+00 I	1.12E+00 I		0.061 C	0.0056 C	0.0029 C	5.2 C	0.58 C	5 E	0.04 E
Tralomethrin	66841256	7.50E-03 I					270 N	27 N	10 N	15000 N	590 N		
Triallate	2303175	1.30E-02 I					470 N	47 N	18 N	27000 N	1000 N		
Triasulfuron	82097505	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
1,2,4-Tribromobenzene	615543	5.00E-03 I				x	30 N	18 N	6.8 N	10000 N	390 N		
Tributyltin oxide (TBTO)	56359	3.00E-05 I					1.1 N	0.11 N	0.041 N	61 N	2.3 N		
2,4,6-Trichloroaniline hydrochloride	33663502			2.90E-02 H			2.3 C	0.22 C	0.11 C	200 C	22 C		
2,4,6-Trichloroaniline	634935			3.40E-02 H			2 C	0.18 C	0.093 C	170 C	19 C		
1,2,4-Trichlorobenzene	120821	1.00E-02 I	5.71e-02 H			x	190 N	210 N	14 N	20000 N	780 N	240 E	2 E
**1,1,1-Trichloroethane	71556	3.50E-02 E	2.86E-01 W			x	790 N	1000 N	47 N	72000 N	2700 N	980 E	0.9 E
1,1,2-Trichloroethane	79005	4.00E-03 I		5.70E-02 I	5.60E-02 I	x	0.19 C	0.11 C	0.055 C	100 C	11 C	0.8 E	0.01 E
Trichloroethylene (TCE)	79016	6.00E-03 E		1.10E-02 W	6.00E-03 E	x	1.6 C	1 C	0.29 C	520 C	58 C	3 E	0.02 E
Trichlorofluoromethane	75694	3.00E-01 I	2.00E-01 A			x	1300 N	730 N	410 N	610000 N	23000 N	790 N	13 N
2,4,5-Trichlorophenol	95954	1.00E-01 I					3700 N	370 N	140 N	200000 N	7800 N	8200 S	120 E
2,4,6-Trichlorophenol	88062			1.10E-02 I	1.09E-02 I		6.1 C	0.57 C	0.29 C	520 C	58 C	150 C	0.06 E
2,4,5-Trichlorophenoxyacetic acid	93765	1.00E-02 I					370 N	37 N	14 N	20000 N	780 N		
2-(2,4,5-Trichlorophenoxy)propionic acid	93721	8.00E-03 I					290 N	29 N	11 N	16000 N	630 N		
1,1,2-Trichloropropane	598776	5.00E-03 I				x	30 N	18 N	6.8 N	10000 N	390 N	13 N	0.14 N
1,2,3-Trichloropropane	96184	6.00E-03 I		7.00e+00 I		x	0.0015 C	0.00089 C	0.00045 C	0.82 C	0.091 C	0.000027 C	0.000006 C
1,2,3-Trichloropropene	96195	5.00E-03 H				x	30 N	18 N	6.8 N	10000 N	390 N		
1,1,2-Trichloro-1,2,2- trifluoroethane	76131	3.00E+01 I	8.57E+00 H			x	59000 N	31000 N	41000 N	1000000 N	1000000 N	2400 S	3100 N
Tridiphane	58138082	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Triethylamine	121448		2.00E-03 I				73 N	7.3 N					
Trifluralin	1582098	7.50E-03 I		7.70E-03 I			8.7 C	0.81 C	0.41 C	740 C	83 C		
1,2,4-Trimethylbenzene	95636	5.00e-02 E				x	300 N	180 N	68 N	100000 N	3900 N		
1,3,5-Trimethylbenzene	108678	5.00e-02 E				x	300 N	180 N	68 N	100000 N	3900 N	98 S	0.26 M
Trimethyl phosphate	512561			3.70E-02 H			1.8 C	0.17 C	0.085 C	150 C	17 C		
1,3,5-Trinitrobenzene	99354	5.00E-05 I					1.8 N	0.18 N	0.068 N	100 N	3.9 N		
Trinitrophenylmethylnitramine	479458	1.00E-02 H					370 N	37 N	14 N	20000 N	780 N		
2,4,6-Trinitrotoluene	118967	5.00E-04 I		3.00E-02 I			2.2 C	0.21 C	0.11 C	190 C	21 C		
Uranium (soluble salts)	7440611	3.00E-03 I					110 N	11 N	4.1 N	6100 N	230 N		
Vanadium	7440622	7.00E-03 H					260 N	26 N	9.5 N	14000 N	550 N		
Vanadium pentoxide	1314621	9.00E-03 I					330 N	33 N	12 N	18000 N	700 N		
Vanadium sulfate	36907423	2.00E-02 H					730 N	73 N	27 N	41000 N	1600 N		
Vernam	1929777	1.00E-03 I					37 N	3.7 N	1.4 N	2000 N	78 N		
Vinclozolin	50471448	2.50E-02 I					910 N	91 N	34 N	51000 N	2000 N		
Vinyl acetate	108054	1.00E+00 H	5.71E-02 I				37000 N	210 N	1400 N	1000000 N	78000 N	370 E	84 E
Vinyl bromide	593602		8.57E-04 I			x	5.2 N	3.1 N	0	0	0	2 N	0.018 N
Vinyl chloride	75014			1.90E+00 H	3.00E-01 H	x	0.019 C	0.021 C	0.0017 C	3 C	0.34 C	0.002 E	0.01 E
Warfarin	81812	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N	0.046 N	1800 N
m-Xylene	108323	2.00E+00 H	2.00E-01 W			x	1400 N	730 N	2700 N	1000000 N	160000 N	950 S	240 M
o-Xylene	95476	2.00E+00 H	2.00E-01 W			x	1400 N	730 N	2700 N	1000000 N	160000 N	730 S	150 M
p-Xylene	106423		8.57E-02 W			x	520 N	310 N	0	0	0	1000 S	220 M
Xylene (mixed)	1330207	2.00E+00 I				x	12000 N	7300 N	2700 N	1000000 N	160000 N	320 E	74 E
Zinc	7440666	3.00E-01 I					11000 N	1100 N	410 N	610000 N	23000 N		42000 E

Sources: I=IRIS H=HEAST A=HEAST alternate W=Withdrawn from IRIS or HEAST E=EPA-NCEA Regional Support provisional value O=Other EPA documents.

Basis : C=carcinogenic effects N=noncarcinogenic effects E=EPA draft Soil Screening Level S=soil saturation concentration M=EPA MCL.

							Risk-Based Concentrations					Soil Screening Levels-Transfers from Soil to:	
										Soil Ingestion			
		RfDo	RfDi	CPSo	CPSi	VOC	Tap Water	Ambient Air	Fish	Industrial	Residential	Air	Groundwater
Contaminant	CAS	mg/kg/d	mg/kg/d	kg·d/mg	kg·d/mg		µg/L	µg/m3	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Zinc phosphide	1314847	3.00E-04 I					11 N	1.1 N	0.41 N	610 N	23 N		
Zineb	12122677	5.00E-02 I					1800 N	180 N	68 N	100000 N	3900 N		

APPENDIX F

FATE AND TRANSPORT MODEL CALCULATIONS AND BIOPLUME II INPUT/OUTPUT FILES

THERMODYNAMIC REACTIONS

APPENDIX F

Corrective Action Plan
Risk-Based Approach to Remediation
MOGAS Site , Myrtle Beach AFB, South Carolina

Electron Donor and Electron Acceptor Half Cell Reactions

HALF-CELL REACTIONS	$\Delta G°_r$ (kcal/ equiv)*	$\Delta G°_r$ (kJ/ equiv)*	E° (V)	Eh (V)	pe	Conditions for Eh and pe §
ELECTRON-ACCEPTOR (REDUCTION) HALF CELL REACTIONS						
$5e^- + 6H^+ + NO_3^- \Rightarrow 0.5N_2 + 3H_2O$ *Denitrification*	-28.7	-120.	+1.24	+0.708	+12.0	pH = 7 $\Sigma[N]=10^{-3}$
$4e^- + 4H^+ + O_2 \Rightarrow 2H_2O$ *Aerobic Respiration*	-28.3	-119.	+1.23	+0.805	+13.6	pH = 7 P_{O_2}=0.21 atm
$2e^- + 4H^+ + \underline{MnO_2} \Rightarrow Mn^{2+} + 2H_2O$ *Pyrolusite Dissolution/Reduction*	-28.3	-119	+1.23	+0.550	+9.27	pH = 7 $\Sigma[Mn]=10^{-5}$
$CO_2 + e^- + H^+ + \underline{MnOOH} \Rightarrow MnCO_3 + H_2O$ *a Manganite Carbonation/Reduction*	-23.1	-96.8	+1.00	+0.408	+6.90	pH = 8 $P_{CO_2}=10^{-2}$
$e^- + H^+ + MnO_2 \Rightarrow \underline{MnOOH}$ *Pyrolusite Hydrolysis/Reduction*	-22.1	-92.5	+0.959	+0.545	+9.21	pH = 7
$e^- + 3H^+ + \underline{Fe(OH)_{3,amph.}} \Rightarrow Fe^{2+} + 2H_2O$ *Amorphous "Goethite" Dissolution/Reduction*	-21.5	-89.9	+0.932	+0.163	+2.75	pH = 6 $\Sigma[Fe]=10^{-5}$
$8e^- + 10H^+ + NO^-_3 \Rightarrow NH^+_4 + 3H_2O$ *Nitrate Reduction*	-20.3	-84.9	+0.879	+0.362	+6.12	pH = 7
$2e^- + 2H^+ + NO^-_3 \Rightarrow NO^-_2 + H_2O$ *Nitrate Reduction*	-18.9	-78.9	+0.819	+0.404	+6.82	pH = 7
$e^- + 3H^+ + \underline{FeOOH} \Rightarrow Fe^{2+} + 2H_2O$ *"Ferric oxyhydroxide" Dissolution/Reduction*	-15.0	-62.9	+0.652	-0.118	-1.99	pH = 6 Σ [Fe]$=10^{-5}$
$e^- + 3H^+ + \underline{Fe(OH)_{3,xline.}} \Rightarrow Fe^{2+} + 3H_2O$ *Crystallized "Goethite" Dissolution/Reduction*	-11.8	-49.2	+0.510	-0.259	-4.38	pH = 6 Σ [Fe]$=10^{-5}$
$e^- + H^+ + CO_{2,g} + \underline{Fe(OH)_{3,amph.}} \Rightarrow \underline{FeCO_3} + 2H_2O$ *Amorphous "Goethite" Carbonation/Reduction*	-11.0	-46.2	+0.479	-0.113	-1.90	pH = 8 $P_{CO_2}=10^{-2}$ atm
$8e^- + 9H^+ + SO^{2-}_4 \Rightarrow HS^- + 4H_2O$ *Sulfate Reduction*	-5.74	-24.0	+0.249	-0.278	-4.70	pH = 8
$8e^- + 10H^+ + SO^{2-}_4 \Rightarrow H_2S^o + 4H_2O$ *Sulfate Reduction*	-6.93	-28.9	+0.301	-0.143	-2.42	pH = 6
$8e^- + 8H^+ + CO_{2,g} \Rightarrow CH_{4,g} + 2H_2O$ *Methanogenesis*	-3.91	-16.4	+0.169	-0.259	-4.39	pH = 7 $P_{CO_2}=10^{-2}$ $P_{CH_4}=10^0$

HALF-CELL REACTIONS	ΔG°_r (kcal/ equiv)*	ΔG°_r (kJ/ equiv)*	E° (V)	Eh (V)	pe	Conditions for Eh and pe §
ELECTRON-DONOR (OXIDATION) HALF CELL REACTIONS						
$12H_20 + C_6H_6 \Rightarrow 6CO_2 + 30H^+ + 30e^-$ *Benzene Oxidation*	+2.83	+11.8	-0.122	+0.316	+5.34	pH = 7 $P_{CO_2}=10^{-2}$
$14H_20 + C_6H_5CH_3 \Rightarrow 7CO_2 + 36H^+ + 36e^-$ *Toluene Oxidation*	+2.96	+12.4	-0.128	+0.309	+5.22	pH = 7 $P_{CO_2}=10^{-2}$
$16H_20 + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 42H^+ + 42e^-$ *Ethylbenzene Oxidation*	+2.96	+12.4	-0.128	+0.309	+5.21	pH = 7 $P_{CO_2}=10^{-2}$
$16H_2O + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 42H^+ + 42e^-$ *m-Xylene Oxidation*	+3.02	+12.7	+0.131	-0.305	-5.88	pH = 7 $P_{CO_2}=10^{-2}$
$20H_2O + C_{10}H_8 \Rightarrow 10CO_2 + 48H^+ + 48e^-$ *Naphthalene Oxidation*	+2.98	+12.5	-0.130[a]	+0.309	+5.22	pH = 7 $P_{CO_2}=10^{-2}$
$18H_2O + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 48H^+ + 48e^-$ *1,3,5-Trimethylbenzene Oxidation*	+3.07	+12.8	-0.133[a]	+0.303	+5.12	pH = 7 $P_{CO_2}=10^{-2}$
$18H_2O + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 48H^+ + 48e^-$ *1,2,4-Trimethylbenzene Oxidation*	+3.07	+12.9	-0.134[a]	+0.302	+5.11	pH = 7 $P_{CO_2}=10^{-2}$
$12H_2O + C_6H_5Cl \Rightarrow 6CO_2 + 29H^+ + 28e^- + Cl^-$ *Chlorobenzene Oxidation*	+2.21	+9.26	-0.096[a]	+0.358	+6.05	pH = 7 $P_{CO_2}=10^{-2}$

NOTES:

* = ΔG°_r for half cell reaction as shown divided by the number of electrons involved in reaction.

§ = Conditions assumed for the calculation of Eh and pe (pe = Eh/0.05916). Where two dissolved species are involved, other than those mentioned in this column, their activities are taken as equal. Note, this does not affect the free energy values listed.

[a] = E° calculated using the following equation; $E^0 = \Delta G^\circ_r (J/nF) * 1.0365x10^{-5}$ (VF/J) from Stumm and Morgan, 1981

Coupled Oxidation Reactions

Coupled Benzene Oxidation Reactions	ΔG°_r (kcal/mole Benzene)	ΔG°_r (kJ/mole Benzene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$7.5O_2 + C_6H_6 \Rightarrow 6CO_{2,g} + 3H_2O$ *Benzene oxidation /aerobic respiration*	-765.34	-3202	3.07:1
$6NO_3^- + 6H^+ + C_6H_6 \Rightarrow 6CO_{2,g} + 6H_2O + 3N_{2,g}$ *Benzene oxidation / denitrification*	-775.75	-3245	4.77:1
$30H^+ + 15\underline{MnO_2} + C_6H_6 \Rightarrow 6CO_{2,g} + 15Mn^{2+} + 18H_2O$ *Benzene oxidation / manganese reduction*	-765.45	-3202	10.56:1
$3.75\ NO_3^- + C_6H_6 + 7.5\ H^+ + 0.75\ H_2O \Rightarrow 6\ CO_2 + 3.75\ NH_4^+$ *Benzene oxidation / nitrate reduction*	-524.1	-2193	2.98:1
$60H^+ + 30\underline{Fe(OH)_{3,a}} + C_6H_6 \Rightarrow 6CO_2 + 30Fe^{2+} + 78H_2O$ *Benzene oxidation / iron reduction*	-560.10	-2343	21.5:1
$7.5H^+ + 3.75SO_4^{2-} + C_6H_6 \Rightarrow 6CO_{2,g} + 3.75H_2S^\circ + 3H_2O$ *Benzene oxidation / sulfate reduction*	-122.93	-514.3	4.61:1
$4.5H_2O + C_6H_6 \Rightarrow 2.25CO_{2,g} + 3.75CH_4$ *Benzene oxidation / methanogenesis*	-32.40	-135.6	0.77:1

Coupled Toluene Oxidation Reactions	ΔG°_r (kcal/mole Toluene)	ΔG°_r (kJ/mole Toluene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$9O_2 + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4H_2O$ *Toluene oxidation /aerobic respiration*	-913.76	-3823	3.13:1
$7.2NO_3^- + 7.2H^+ + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 7.6H_2O + 3.6N_{2,g}$ *Toluene oxidation / denitrification*	-926.31	-3875	4.85:1
$36H^+ + 18\underline{MnO_2} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 18Mn^{2+} + 22H_2O$ *Toluene oxidation / manganese reduction*	-913.89	-3824	10.74:1
$72H^+ + 36\underline{Fe(OH)_{3,a}} + C_6H_5CH_3 \Rightarrow 7CO_2 + 36Fe^{2+} + 94H_2O$ *Toluene oxidation / iron reduction*	-667.21	-2792	21.86:1
$9H^+ + 4.5SO_4^{2-} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4.5H_2S^\circ + 4H_2O$ *Toluene oxidation / sulfate reduction*	-142.86	-597.7	4.7:1
$5H_2O + C_6H_5CH_3 \Rightarrow 2.5CO_{2,g} + 4.5CH_4$ *Toluene oxidation / methanogenesis*	-34.08	-142.6	0.78:1

Coupled Ethylbenzene Oxidation reactions	ΔG°_r kcal/mole Ethylbenzene	ΔG°_r kJ/mole Ethylbenzene	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$10.5O_2 + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5H_2O$ *Ethylbenzene oxidation /aerobic respiration*	-1066.13	-4461	3.17:1
$8.4NO_3^- + 8.4H^+ + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ *Ethylbenzene oxidation / denitrification*	-1080.76	-4522	4.92:1
$46H^+ + 22\underline{MnO_2} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 22Mn^{2+} + 28H_2O$ *Ethylbenzene oxidation / manganese reduction*	-1066.27	-4461	11.39:1
$84H^+ + 42\underline{Fe(OH)_{3,a}} + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *Ethylbenzene oxidation / iron reduction*	-778.48	-3257	22.0:1
$10.5H^+ + 5.25SO_4^{2-} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5.25H_2S^\circ + 5H_2O$ *Ethylbenzene oxidation / sulfate reduction*	-166.75	-697.7	4.75:1
$5.5H_2O + C_6H_5C_2H_5 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ *Ethylbenzene oxidation / methanogenesis*	-39.83	-166.7	0.79:1

Coupled m-Xylene Oxidation Reactions	ΔG°_r (kcal/mole *m*-xylene)	ΔG°_r (kJ/mole *m*-xylene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$10.5O_2 + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5H_2O$ *m-Xylene oxidation /aerobic respiration*	-1063.25	-4448	3.17:1
$8.4NO_3^- + 8.4H^+ + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ *m-Xylene oxidation / denitrification*	-1077.81	-4509	4.92:1
$46H^+ + 22\underline{MnO_2} + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 22Mn^{2+} + 28H_2O$ *m-Xylene oxidation / manganese reduction*	-1063.39	-4449	11.39:1
$84H^+ + 42\underline{Fe(OH)_{3,a}} + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *m-Xylene oxidation / iron reduction*	-775.61	-3245	22:1
$10.5H^+ + 5.25SO_4^{2-} + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5.25H_2S^{\circ} + 5H_2O$ *m-Xylene oxidation / sulfate reduction*	-163.87	-685.6	4.75:1
$5.5H_2O + C_6H_4(CH_3)_2 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ *m-Xylene oxidation / methanogenesis*	-36.95	-154.6	0.79:1 [a]

Coupled Naphthalene Oxidation Reactions	ΔG°_r (kcal/mole naphthalene)	ΔG°_r (kJ/mole naphthalene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$12O_2 + C_{10}H_8 \Rightarrow 10CO_2 + 4H_2O$ *Naphthalene oxidation /aerobic respiration*	-1217.40	-5094	3.00:1
$9.6NO_3^- + 9.6H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 8.8H_2O + 4.8N_{2,g}$ *Naphthalene oxidation / denitrification*	-1234.04	-5163	4.65:1
$24MnO_2 + 48H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 24Mn^{2+} + 28H_2O$ *Naphthalene oxidation / manganese reduction*	-1217.57	-5094	16.31:1
$48Fe(OH)_{3,a} + 96H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 48Fe^{2+} + 124H_2O$ *Naphthalene oxidation / iron reduction*	-932.64	-3902	40.13:1
$6SO_4^{2-} + 12H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 6H_2S^{\circ} + 4H_2O$ *Naphthalene oxidation / sulfate reduction*	-196.98	-824.2	4.50:1
$8H_2O + C_{10}H_8 \Rightarrow 4CO_2 + 6CH_4$ *Naphthalene oxidation / methanogenesis*	-44.49	-186.1	1.13:1

Coupled 1,3,5-Trimethylbenzene Oxidation Reactions	ΔG°_r (kcal/mole 1,3,5-TMB)	ΔG°_r (kJ/mole 1,3,5-TMB)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$12O_2 + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 6H_2O$ *1,3,5-Trimethylbenzene oxidation /aerobic respiration*	-1213.29	-5076	3.20:1
$9.6NO_3^- + 9.6H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 10.8H_2O + 4.8N_{2,g}$ *1,3,5-Trimethylbenzene oxidation / denitrification*	-1229.93	-5146	4.96:1
$24MnO_2 + 48H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 30H_2O + 24Mn^{2+}$ *1,3,5-Trimethylbenzene oxidation / manganese reduction*	-1213.46	-5077	17.40:1
$48Fe(OH)_{3,a} + 96H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 48Fe^{2+} + 126H_2O$ *1,3,5-Trimethylbenzene oxidation / iron reduction*	-928.53	-3885	42.80:1
$6SO_4^{2-} + 12H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 6H_2O + 6H_2S^{\circ}$ *1,3,5-Trimethylbenzene oxidation / sulfate reduction*	-192.87	-807.0	4.80:1
$6H_2O + C_6H_3(CH_3)_3 \Rightarrow 3CO_2 + 6CH_4$ *1,3,5-Trimethylbenzene oxidation / methanogenesis*	-40.39	-169.0	0.90:1

Gibbs Free Energy of Formation for Species used in Half-Cell reactions and Coupled Oxidation-Reduction Reactions

Species	State	$\Delta G^o_{f,298.15}$ (kcal/mole)	Source
e^-	i	0	std
H^+	i	0	std
O_2	g	0	std
H_2O	l	-56.687	Dean (1972)
Carbon Species			
CO_2	g	-94.26	Dean (1972)
CH_2O, formalydehyde	aq	-31.02	Dean (1972)
C_6H_6, benzene	l	+29.72	Dean (1972)
CH_4, methane	g	-12.15	Dean (1972)
$C_6H_5CH_3$, toluene	l	+27.19	Dean (1972)
$C_6H_5C_2H_5$, ethylbenzene	l	+28.61	Dean (1972)
$C_6H_4(CH_3)_2$, o-xylene	l	+26.37	Dean (1972)
$C_6H_4(CH_3)_2$, m-xylene	l	+25.73	Dean (1972)
$C_6H_4(CH_3)_2$, p-xylene	l	+26.31	Dean (1972)
C_2Cl_4, PCE	l	+1.1	CRC Handbook (1990)
C_2HCl_3, TCE	l	+2.9	CRC Handbook (1990)
$C_2H_2Cl_2$, c-DCE	l	+5.27	CRC Handbook (1990)
C_2H_4, ethene	g	+16.28	CRC Handbook (1990)
$C_{10}H_8$, naphthalene	l	+48.05	Dean (1972)
$C_6H_3(CH_3)_3$, 1,3,5-TMB	l	+24.83	Dean (1972)
$C_6H_3(CH_3)_3$, 1,2,4-TMB	l	+24.46	Dean (1972)
C_2H_3Cl, vinyl chloride	g	+12.4	Dean (1972)
C_6H_5Cl, chlorobenzene	l	+21.32	Dean (1972)
$C_{14}H_{10}$, phenanthrene	l	+64.12	Dean (1972)
Nitrogen Species			
NO_3^-	i	-26.61	Dean (1972)
N_2	g	0	std
NO_2^-	i	-7.7	Dean (1972)
NH_4^+	aq	-18.97	Dean (1972)
Sulfur Species			
SO_4^{2-}	i	-177.97	Dean (1972)
H_2S	aq	-6.66	Dean (1972)
H_2S	g	-7.9	Dean (1972)
HS^-	i	+2.88	Dean (1972)
Iron Species			
Fe^{2+}	i	-18.85	Dean (1972)
Fe^{3+}	i	-1.1	Dean (1972)
Fe_2O_3, hematite	c	-177.4	Dean (1972)
FeOOH, ferric oxyhydroxide	c	-117.2	Naumov *et al.* (1974)
$Fe(OH)_3$, goethite	a	-167.416	Langmuir and Whittemore (1971)
$Fe(OH)_3$, goethite	c	-177.148	Langmuir and Whittemore (1971)
$FeCO_3$, siderite	c	-159.35	Dean (1972)
Manganese Species			
Mn^{2+}	i	-54.5	Dean (1972)
MnO_2, pyrolusite	c	-111.18	Stumm and Morgan (1981)
MnOOH, manganite	c	-133.29	Stumm and Morgan (1981)
$MnCO_3$, rhodochrosite	p	-194	Dean (1972)
Chloride Species			
Cl^-	aq	-31.37	Dean (1972)

k:\myrtle\tables\appendxf.doc

Coupled 1,2,4-Trimethylbenzene Oxidation Reactions	ΔG°_r (kcal/mole 1,2,4-TMB)	ΔG°_r (kJ/mole 1,2,4-TMB)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$12O_2 + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 6H_2O$ *1,2,4-Trimethylbenzene oxidation /aerobic respiration*	-1212.92	-5075	3.20:1
$9.6NO_3^- + 9.6H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 10.8H_2O + 4.8N_{2,g}$ *1,2,4-Trimethylbenzene oxidation / denitrification*	-1229.56	-5144	4.96:1
$24\underline{MnO_2} + 48H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 30H_2O + 24Mn^{2+}$ *1,2,4-Trimethylbenzene oxidation / manganese reduction*	-1213.09	-5076	17.4:1
$6SO_4^{2-} + 12H^+ + C_6H_3(CH_3)_3 \Rightarrow 9CO_2 + 6H_2O + 6H_2S^o$ *1,2,4-Trimethylbenzene oxidation / sulfate reduction*	-192.50	-805.4	4.80:1
$6H_2O + C_6H_3(CH_3)_3 \Rightarrow 3CO_2 + 6CH_4$ *1,2,4-Trimethylbenzene oxidation / methanogenesis*	-40.02	-167.4	0.90:1

Coupled Chlorobenzene Oxidation Reactions	ΔG°_r (kcal/mole Chlorobenzene)	ΔG°_r (kJ/mole Chlorobenzene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$7O_2 + C_6H_5Cl \Rightarrow 6CO_2 + H^+ + 2H_2O + Cl^-$ *Chlorobenzene oxidation /aerobic respiration*	-731.62	-3061	2.00:1
$5.6NO_3^- + 4.6H^+ + C_6H_5Cl \Rightarrow 6CO_2 + 4.8H_2O + 2.8N_{2,g} + Cl^-$ *Chlorobenzene oxidation / denitrification*	-741.33	-3102	3.10:1
$14\underline{MnO_2} + 27H^+ + C_6H_5Cl \Rightarrow 6CO_2 + 16H_2O + 14Mn^{2+} + Cl^-$ *Chlorobenzene oxidation / manganese reduction*	-731.72	-3062	10.9:1
$28\underline{Fe(OH)}_{3,a} + 55H^+ + C_6H_5Cl \Rightarrow 6CO_2 + 72H_2O + 28Fe^{2+} + Cl^-$ *Chlorobenzene oxidation / iron reduction*	-565.51	-2366	26.8:1
$3.5SO_4^{2-} + 6H^+ + C_6H_5Cl \Rightarrow 6CO_2 + 2H_2O + 3.5H_2S^o + Cl^-$ *Chlorobenzene oxidation / sulfate reduction*	-136.38	-570.6	3.00:1
$5H_2O + C_6H_5Cl \Rightarrow 2.5CO_2 + 3.5CH_4 + H^+ + Cl^-$ *Chlorobenzene oxidation / methanogenesis*	-47.43	-198.4	0.80:1

NOTES:

c = crystallized solid
a = amorphous solid (may be partially crystallized - dependent on methods of preparation)
p = freshly precipitated solid
i = dissociated, aqueous ionic species (concentration = 1 m)
aq = undissociated aqueous species
g = gaseous
l = liquid
std = accepted by convention
Wherever possible multiple sources were consulted to eliminate the possibility of typographical error.

BATCH FLUSH MODEL SETUP AND RESULTS

PARSONS

Calculation Sheet

Rev	By	Date	Ck	Date	Title	Contaminant Leaching Calcs. – Simulated Batch Flush Model (Saturated) Myrtle Beach MOGAS Site
					Author	JRH 5/9/96 Sheet 1 Of 3

Knowns:

a) Linear GW velocity = ~0.1 ft/day = 0.03 m/day

b) porosity = ~0.25

c) soil bulk density = ~1.65 g/cm^3

d) Distribution coefficient (kd) for benzene = 0.067

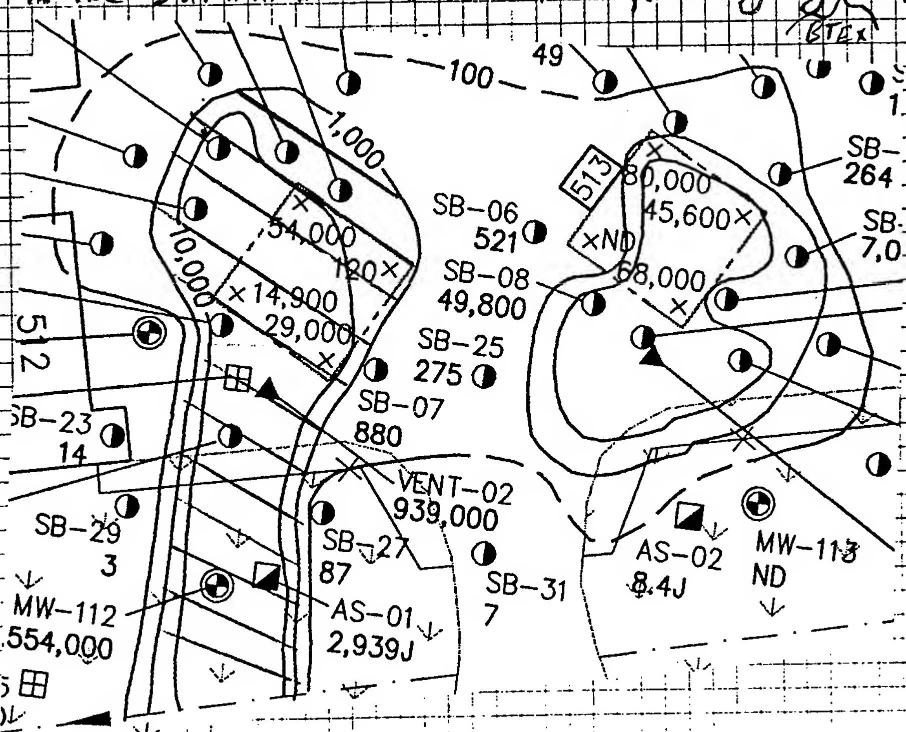
e) Starting groundwater concentration (benzene) = 5,960 ug/L at MOV-01-03
(max. detected benzene concentration)

Assumptions:

a) 100% of equilibrium will be reached with each flush

b) Simulated reactor volume = Volume of contaminated soil in the saturated zone within the 1,000 mg/kg isopleth (see below)
BTEX

1" = 60'



Assume that contaminated soil extends 2.5' below water table on average

PARSONS Calculation Sheet

Rev	By	Date	Ck	Date	Title
					Author JRH 5/9/96 Sheet 2 Of 3

Soil volume can be approximated by an 80' diameter circle + a 40' x 110' rectangle.

$$V = (\pi)(40')^2(2.5') + (40')(110')(2.5')$$
$$= 12564 + 11000$$
$$= 23{,}564\ ft^3 = 667\ m^3$$

$$\text{Mass of soil} = (1.65\ g/cm^3)\left(\frac{10^6\ cm^3}{m^3}\right)\left(\frac{1kg}{1000g}\right)(667\ m^3)$$
$$= 1{,}100{,}550\ kg = 1650\ kg/m^3$$

$$\text{Mass of water} = (1\ g/cm^3)\left(\frac{0.25\ cm^3\ H_2O}{cm^3\ aquifer}\right)\left(\frac{10^6\ cm^3}{m^3}\right)\left(\frac{1kg}{1000g}\right) \times (667\ m^3)$$
$$= 166{,}750\ kg = 250\ kg/m^3$$

2) New volume of H_2O will pass through soil mass approximately every 5.2 years (West UST Area)

$$190' \div 0.1\ ft/day = 1{,}900\ days = 5.2\ yr$$
(say 5 yr)

190' — length of contaminated zone inside 6000 mg/kg contour

0.1 ft/day — GW velocity

For East UST Area, it can reasonably be assumed that there is a similar residence time because soil contamination may extend to the creek.

$$160' \div 0.1\ ft/day = 1{,}600\ days = 4.4\ years$$

PARSONS

Calculation Sheet

Rev	By	Date	Ck	Date	Title Saturated Batch Flush
					Author JRA 5/9/96 Sheet 3 Of 3

Equations

a) $kd = \frac{\mu g/kg}{\mu g/L} = \frac{\text{mass adsorbed to soil}}{\text{mass dissolved in GW}}$

$\therefore \mu g/L = (\mu g/kg)/kd$

b) $M_{s\,new}$ = mass of contaminant in $\underbrace{\text{contaminated}}_{\text{soil in}}$ volume (pg. 1)
$M_{s\,old}$ = " " " " soil
M_w = " " " " water

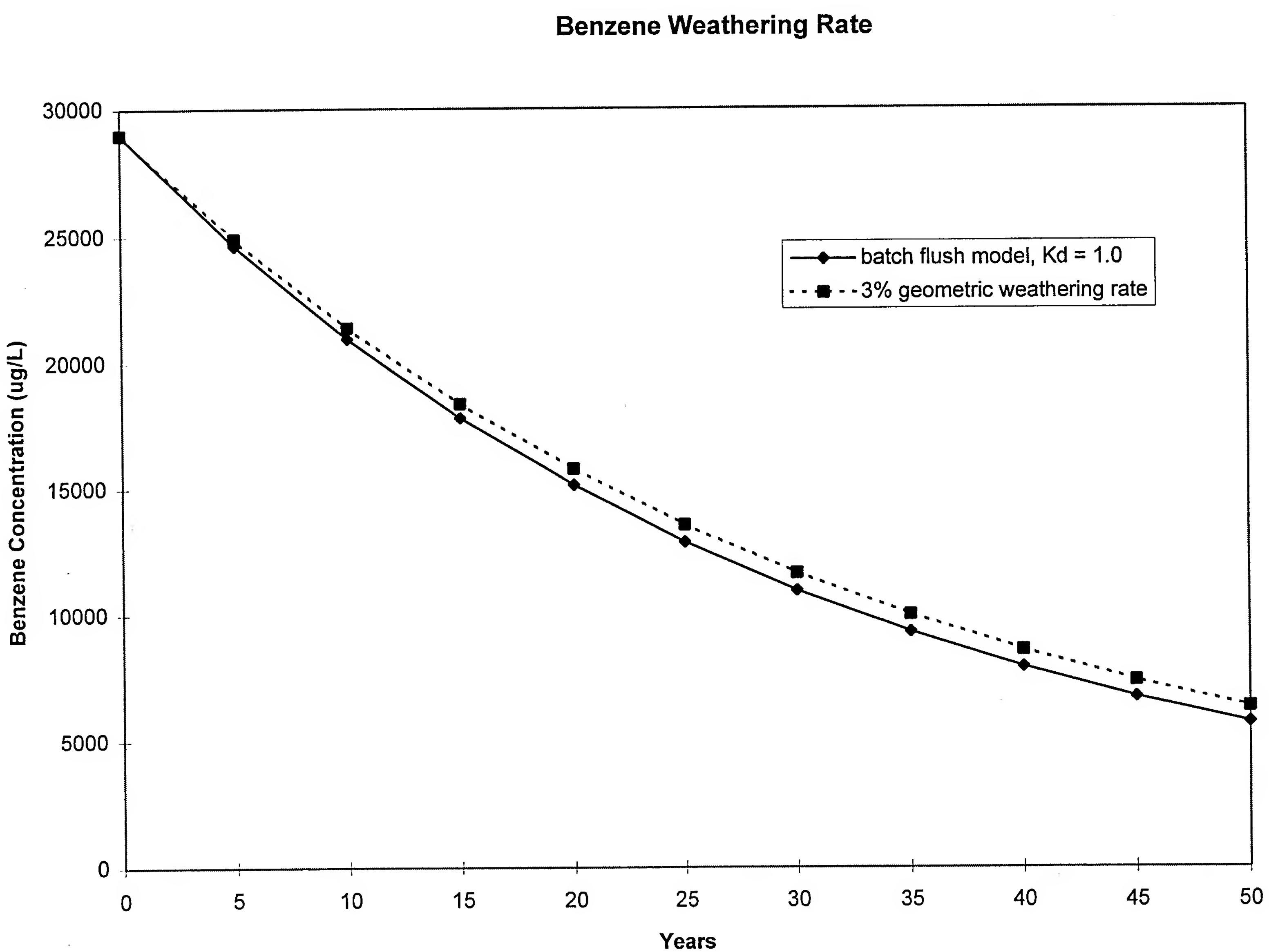
$M_{s\,new} = M_{s\,old} - M_w$

$\mu g/kg = \mu g/kg - \mu g/L \longrightarrow$ need to correct for density

remember: $\frac{250\ l/m^3}{1650\ kg/m^3} = 0.15\ l/kg$

$\therefore \mu g/kg\ (\text{remaining}) = \mu g/kg_{\text{initial}} - \left[(\mu g/L_{\text{leached}})(0.15\ l/kg) \right]$

The following spreadsheet shows these calculations for benzene.


Benzene Weathering Rate
Benzene Concentration (ug/L)
30000
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
30
35
40
45
50
Years
batch flush model, Kd = 1.0
3% geometric weathering rate

Use of a literature-based Kd in the batch flush model yields unreasonably elevated groundwater concentrations. For example,

$$K_d = \frac{\mu g/kg}{\mu g/L} = \frac{\text{mass adsorbed to soil}}{\text{mass dissolved in GW}}$$

$$\mu g/L = \frac{\mu g/kg}{K_d} \qquad \mu g/kg = \mu g/L \times K_d$$

Soil Benzene concentrations at the W. UST area range up to 29,000 µg/kg at Vent-02, 11-13 ft bgs. Using Kd = 0.198 L/kg, derived from a literature value of Koc and the max. soil TOC detected at the MOGAS site, the dissolved benzene concentration in GW = 146,465 µg/L:

$$\frac{29{,}000\ \mu g/kg}{0.198\ L/kg} = 146{,}465\ \mu g/L$$

The highest detected benzene conc. in GW was 5,960 µg/L. Use of this Kd value may result in overprediction of benzene leaching rates.

The average 1993-1995 soil benzene concentration near the water table at 9 boreholes located within the 10,000 µg/kg BTEX isopleth at the Western UST area (Figure 5.3) is:

	Borehole ID	Sample Depth (ft bgs)	Benzene (µg/kg)
	SB-21	6-8	350
	Vent-02	11-13	29,000
	* SB-03	8-10	15,000
	* SB-11	8-10	1,300
	SB-05	8-10	3,300
Bottom of Excavation Samples	* North Corner	~10'	<1,000 (assume 500)
Bottom of Excavation Samples	* West Corner	~10'	2,000
Bottom of Excavation Samples	South Corner	~10'	<1,000 (assume 500)
	* SB-09	8-10	1,600
		Average =	5,950 µg/kg

If only the samples collected between the south corner of the UST location and the ditch are used, then the average becomes 8,287 µg/kg. (Values that don't have *)

The best estimate of the level of dissolved benzene in GW that this soil contamination is producing are data from MW-112 & MOC-01-03, which had benzene levels of 5,000 µg/L & 5,960 µg/L, respectively

The higher value (5,960 ug/L) is probably most representative because MOC-01-03 had a shorter screen interval (1') positioned at the water table.

$$Kd = \frac{5{,}922 \ \mu g/kg}{5{,}960 \ \mu g/L} = 1.0 \ kg/L$$ – This may be a more accurate kd for this site

Using the average of 8,225 ug/kg, Kd = 1.4 kg/L

Try another Calculation:

In 1988, a soil sample collected at 5-7' depth (from MW-112) had 14,000 ug/kg benzene. Groundwater from this well (sampled in 1988) had a benzene conc. of 7,600 – 14,000 ug/L (2 consecutive samplings)

$$Kd = \frac{14{,}000 \ \mu g/kg}{7{,}600 \ \mu g/L} = 1.8 \ kg/L$$

$$= \frac{14{,}000 \ \mu g/kg}{14{,}000 \ \mu g/L} = 1.0 \ kg/L$$

All of these analyses yield Kd values of 1.0 to 1.8. Use the value of 1.0 in the batch flush model as it is most similar to the values computed using site-specific TOC values & literature Koc values, yet will yield a reasonably conservative benzene leaching rate.

BIOPLUME MODEL SETUP AND RESULTS

F1.0 OVERVIEW AND MODEL DESCRIPTION

To help estimate how dissolved benzene, toluene, ethylbenzene, and xylene (BTEX) compounds will migrate in groundwater at the MOGAS site under the influence of natural chemical attenuation processes, a quantitative numerical groundwater flow and contaminant transport model that provides for *in situ* biodegradation of contaminant mass was used. The modeling effort was conducted as part of the risk-based remedial evaluation process to identify the contaminant mass and concentration that would be expected to persist in impacted media over time. The numerical model was developed using site-specific data and conservative assumptions about governing physical and chemical processes. Due to the conservative nature of the model input, the reduction in contaminant mass resulting from natural attenuation processes is expected to exceed model predictions.

The Bioplume II code was used to estimate the nature and extent of migration of an indicator compound, benzene, in groundwater at the MOGAS site, accounting for the effects of natural chemical attenuation mechanisms on contaminant mass, concentration, mobility, and persistence (and therefore, toxicity). The Bioplume II model incorporates advection, dispersion, sorption, and biodegradation to simulate contaminant plume migration and attenuation. The model is based upon the US Geological Survey Method of Characteristics two-dimensional (2-D) solute transport model of Konikow and Bredehoeft (1978). The model was modified by researchers at Rice University to include a biodegradation component that can be activated by a superimposed dissolved oxygen (DO) plume. Based on the work of Borden and Bedient (1986), the model assumes a reaction between DO and BTEX mass that is instantaneous relative to the advective groundwater velocity. Bioplume II solves the USGS 2-D solute transport equation twice, once for total BTEX concentrations in the aquifer and once for a DO plume. The two plumes are combined using superposition at every particle move to simulate the instantaneous, biologically-mediated reaction between total BTEX and DO.

However, in addition to oxygen reduction, it has become apparent that anaerobic processes such as denitrification, manganese reduction, ferric iron reduction, sulfate reduction, and methanogenesis can be important fuel hydrocarbon degradation mechanisms (Grbic´-Galic´, 1990; Beller *et al.*, 1992; Edwards *et al.*, 1992; Edwards and Grbic´-Galic´, 1992; Grbic´-Galic´ and Vogel, 1987; Lovley *et al.*, 1989; Hutchins, 1991). Therefore, sole reliance on DO-activated degradation in the numerical model may severely underestimate the effects of natural chemical attenuation processes on contaminant mass, concentration, and mobility over time. To account for these substantial destructive chemical attenuation processes in model simulations, it also is possible to simulate both anaerobic and aerobic contaminant biodegradation in Bioplume II using a site-specific decay constant. This was the modeling approach pursued for the MOGAS site because the site-specific geochemical evidence discussed in Section 6 of the Corrective Action Plan (CAP) suggests that anaerobic biodegradation of fuel hydrocarbon compounds is occurring at the site via ferric iron reduction, sulfate reduction, and methanogenesis. By basing the decay constant on site-specific data and observed chemical attenuation at the field scale, the numerical model accounts for the limiting effects of mass transfer, mixing, and biodegradation kinetics

on contaminant mass loss estimates. The following subsections discuss this approach and other model input parameters, model assumptions, model calibration, and the simulation results in further detail.

F2.0 CONCEPTUAL MODEL DESIGN AND ASSUMPTIONS

Prior to developing a groundwater model, it is important to determine if sufficient data are available to provide a reasonable estimate of aquifer conditions. In addition, it is important to ensure that any limiting assumptions can be justified. Data and information presented in CAP Section 6 suggest that at least oxygen, ferric iron, sulfate, and carbon dioxide are being used as electron acceptors during both aerobic and anaerobic biodegradation of fuel hydrocarbons. As discussed previously, the combined effect of these chemical decay processes is incorporated into the model through use of a site-specific decay constant.

Based on the data presented in CAP Section 3, the shallow saturated zone was conceptualized and modeled as a shallow, unconfined, relatively homogenous aquifer composed primarily of sand overlying an aquitard consisting of silt and clay. The modeled saturated thickness of the aquifer was 10 feet, which is the approximate thickness of the upper groundwater zone of the surficial aquifer. Based on the estimated potentiometric surface and the observed configuration of the dissolved contaminant plume at the site, shallow groundwater flows from the former underground storage tank (UST) locations directly toward the drainage ditch along the southern site boundary. The relatively low magnitude of dissolved contaminant concentrations detected south of the ditch, and the presence of fuel contaminants in the ditch sediment and surface water, indicate that groundwater and dissolved contaminants migrating from the former UST locations in the shallow groundwater zone primarily discharge to the ditch. Therefore, the ditch acts as a barrier that prevents the majority of dissolved contamination from migrating further to the south.

The use of a 2-D model is appropriate at the MOGAS site because the shallow groundwater zone is thin, and the presence of a laterally extensive aquitard composed primarily of silt and clay appears to minimize vertical groundwater flow and contaminant migration. The sources of fuel contamination at the site are the two former UST locations between Building 514 and the southern drainage ditch. Contaminated soils are present at the site in the vadose zone, capillary fringe, and saturated zone, and act as a continuing source of dissolved groundwater contamination. The occasional presence of a hydrocarbon sheen on the water surface in portions of the drainage ditch suggests that a localized sheen also may be present on the groundwater surface; however, recoverable volumes of mobile light nonaqueous-phase liquid (LNAPL) do not appear to be present. A 103-day-long SVE pilot test has reduced the mass of volatile hydrocarbons present in vadose zone soils since soil and groundwater quality data were last collected at the site (see Section 7 of the CAP).

F3.0 INITIAL MODEL SETUP

Where possible, the initial setup for the Bioplume II model was based on site-specific data. Where site-specific data were not available (e.g., effective porosity), reasonable assumptions for the types of materials comprising the shallow aquifer were

made based on widely-accepted literature values. The following sections describe the basic model setup.

F3.1 Grid Design and Boundary Conditions

The maximum grid size for the Bioplume II model is limited to 20 columns by 30 rows. The dimension of each column and row can range from 0.1 to 999.9 feet. A 20- by 30-cell grid was used to model the MOGAS site. Each grid cell was 16 feet long in the east-west direction and 14 feet wide in the north-south direction. The grid encompasses the existing dissolved plume with sufficient space between all model boundaries to avoid significant numerical errors caused by contact between the boundary and the contaminant plume. The model grid covers an area of 134,400 square feet, or approximately 3 acres. The full extent of the model grid and observed dissolved benzene concentrations (August/September 1995) are shown on Figure F.1.

Model boundaries are mathematical statements that represent hydrogeologic boundaries, such as areas of specified head (i.e., surface water bodies or contour lines of constant hydraulic head) or specified flux. Hydrogeologic boundaries are represented by three mathematical statements that describe the hydraulic head at the model boundaries. These include:

- Specified-head boundaries (Dirichlet condition) for which the head is determined as a function of location and time only. Surface water bodies exhibit constant head conditions. Specified-head boundaries are expressed mathematically as:

$$Head = f(x,y,z,t)$$

where f is the function symbol, x, y, and z are position coordinates, and t is time.

- Specified-flow boundaries (Neumann conditions) for which the mathematical description of the flux across the boundary is given. The flux is defined as a volumetric flow rate per unit area (i.e., $ft^3/ft^2/day$). No-flow boundaries are a special type of specified-flow boundary and are set by specifying the flux to be zero. Examples of no-flow boundaries include groundwater divides and impermeable hydrostratigraphic units. Specified-flux boundaries are expressed mathematically as:

$$Flux = f(x,y,z,t)$$

- Head-dependent flow boundaries (Cauchy or mixed-boundary conditions) where the flux across the boundary is calculated from a given boundary head value. This type of flow boundary is sometimes referred to as a mixed-boundary condition because it is a combination of a specified-head boundary and a specified-flow boundary. Head-dependent flow boundaries are used to model leakage across semipermeable boundaries. Head-dependent flow boundaries are expressed mathematically as (Bear, 1979):

FIGURE F.1

MODEL GRID SUPERIMPOSED ON DISSOLVED BENZENE ISOPLETHS PHASE II-AUGUST/SEPTEMBER 1995

MOGAS Site Corrective Action Plan
Risk-Based Approach to Remediation
Myrtle Beach AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

K:\AFCEE\725522\96DN0662, 08/16/96 at 13:11

$$Flux = \frac{(H_0 - H)K'}{B'}$$

Where: H = Head in the zone being modeled (generally the zone containing the contaminant plume)

H_0 = Head in external zone (separated from plume by semipermeable layer)

K' = Hydraulic conductivity of semipermeable layer

B' = Thickness of semipermeable layer.

Natural hydraulic boundaries are modeled using a combination of the three types of model boundary conditions listed above. When possible, hydrologic boundaries such as surface water bodies, groundwater divides, contour lines, or hydrologic barriers should coincide with the perimeter of the model. In areas lacking obvious hydrologic boundaries, specified-head or specified-flux boundaries can be specified at the model perimeter if the boundaries are far enough removed from the contaminant plume that transport calculations are not affected. Bioplume II requires the entire model domain to be bounded by zero-flux cells (also known as no-flow cells), with other boundary conditions established within the subdomain specified by the no-flow cells.

Specified-head boundaries for the model were set on the northern and southern perimeter of the model grid to simulate groundwater flow to the south as observed at the site. The head along the northern model boundary was estimated to be 16.20 feet above mean sea level (MSL). The heads at the southern boundary (at the drainage ditch) varied from 14.14 feet above MSL at the downstream end of the ditch to 14.68 feet above MSL at the upstream end of the ditch.

The eastern and western model boundaries were configured as no-flow (specified-flux) boundaries. In this case, the flux through these boundaries is assumed to be zero because groundwater flow is generally parallel to these boundaries. The base or lower boundary of the model is also assumed to be no-flow, and is representative of the upper surface of the silt and clay aquitard. The upper model boundary is defined by the simulated water table surface. On the basis of aquifer thickness data (CAP Section 3), the saturated thickness of the aquifer was assumed to be approximately 10 feet. Hydraulic conductivity values measured at the site were relatively uniform (Section 3); therefore, a constant hydraulic conductivity and transmissivity were used. Flow hydraulics were matched in the model by varying the upgradient and downgradient constant-head values until the simulated lateral hydraulic gradient and groundwater flow velocities matched measured values to a reasonable degree.

F3.2 Groundwater Elevation and Gradient

The water table elevation map for August 1995, presented in CAP Figure 3.4, was used to define the starting heads input into the Bioplume II model. Groundwater flow in the vicinity of the MOGAS site is to the south at an average estimated gradient in the modeled area of approximately 0.006 foot per foot (ft/ft). The southerly flow direction

in the modeled portion of the shallow groundwater zone has been documented during several different investigations conducted at different times, and appears to be representative of steady state conditions.

F3.3 BENZENE CONCENTRATIONS

The August-September 1995 dissolved benzene concentrations obtained from laboratory analytical results for each sampled monitoring well and point location were used for model development. The January 1995 benzene concentration for monitoring point MOV-01-03 also was used, because this point was removed prior to the August-September sampling event. Appendix B presents dissolved benzene data from the January and August-September 1995 sampling events. Figure F.1 presents the probable extent of benzene in groundwater based on these 1995 data. As described in CAP Section 6, this model was calibrated using existing contaminant data and current site conditions to predict how dissolved contaminants would migrate in the future.

F3.4 Contaminant Decay Coefficient

The discussion presented in Section 6 suggests that oxygen, sulfate, carbon dioxide, and ferric iron are being used as electron acceptors during fuel hydrocarbon biodegradation at the MOGAS site. The modeling strategy pursued at this site involved using a benzene decay coefficient that was as site-specific as possible to account for both aerobic and anaerobic processes.

As described in Section 6 of the CAP, sufficient data were not available for the MOGAS site to compute a site-specific benzene decay rate, because the available decay rate calculation methods require that groundwater analytical data for a minimum of two sampling stations (preferably at least three) located along a line parallel to groundwater flow and contaminant migration (preferably along the axis of the plume) are available. In addition, the stations should be far enough apart that significant contaminant concentration changes due to the effects of biodegradation are evidenced from one station to the next. These conditions are not fulfilled at the MOGAS site. The highest contaminant and tracer concentrations were detected downgradient from the former UST locations near the drainage ditch and the toe of the dissolved plume. However, an anaerobic decay rate constant for benzene of 0.0004 day^{-1} was computed from data collected at the adjacent POL Bulk Fuel Storage Area using the method of Buscheck and Alcantar (1995), and was used in concert with decay rates for the other BTEX compounds for predictive purposes in the calibrated numerical fate and transport model constructed for that site (Parsons ES, 1995). The POL Area, which is hydrogeologically similar to the MOGAS site, is located immediately west of the MOGAS site across Third Street. The method of Buscheck and Alcantar (1995) involves using a simple regression technique to develop a site-specific decay coefficient (see referenced paper in this appendix). With this method, the decay coefficient is determined by coupling the regression of concentration versus distance for a dissolved plume assumed to be under steady-state conditions. This technique provides an analytical method to use site data to distinguish contaminant mass losses due to nondestructive chemical attenuation processes from contaminant mass losses due to destructive attenuation processes. Figure F.2 illustrates how POL area data were used

FIGURE F.2

FIRST-ORDER DEACY RATE CONSTANT CALCULATION USING THE METHOD OF BUSCHECK AND ALCANTAR (1995)

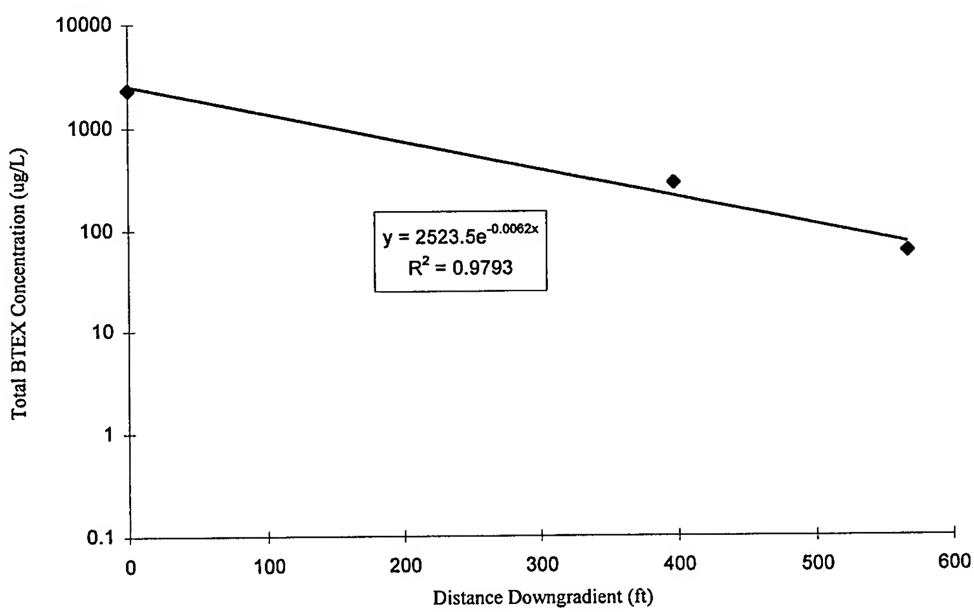
MOGAS SITE CORRECTIVE ACTION PLAN

RISK-BASED APPROACH TO REMEDIATION

MYRTLE BEACH AFB, SOUTH CAROLINA

Point	Distance Down-gradient (ft)	Benzene (ug/L) Jan-95
MW-4	0	2310
MW-2	397	289
MP-15S	567	61

PLOT OF TOTAL T, E, & X CONCENTRATION VERSUS DISTANCE



$\lambda = v_c/4\alpha_x([1+2\alpha_x(k/v_x)]^2-1)$

where	$v_c =$	0.06	(ft/day)
	$\alpha_x =$	8	
	$k/v =$	0.0062	
therefore	$\lambda =$	3.90E-04	

k:\myrtle\busch1.xls

to derive the decay coefficient for benzene that was used in the model for the MOGAS site. The decay coefficient determined for benzene at the POL Area is conservatively low compared to the saturated soil and groundwater degradation rates for this and similar compounds found in the technical literature.

F4.0 MODEL CALIBRATION

Model calibration is an important component in the development of any numerical groundwater model. Calibration of the flow model demonstrates that the model is capable of matching hydraulic conditions observed at the site. Calibration of a contaminant transport model superimposed upon the calibrated flow model helps verify that contaminant loading and transport conditions are being appropriately simulated. The shallow groundwater flow system between the contamination sources (the former UST locations) and the contamination discharge area (the drainage ditch) appears to be relatively homogenous, and the distance between source and discharge area is short (100 feet). Therefore, the numerical flow model developed for the MOGAS site was calibrated to simulate the southerly flow and contaminant migration observed at the site, but did not incorporate substantial heterogeneity. After calibration of the flow model, the numerical transport model was calibrated by altering benzene injection concentrations in a trial-and-error fashion until the simulated benzene plume approximated observed field values. Table F.1 lists input parameters used for the modeling effort.

F4.1 Water Table Calibration

The shallow water table at the MOGAS site was assumed to only be influenced by continuous recharge and discharge at the constant-head cells established at the upgradient and downgradient model boundaries. The drainage ditch bordering the site on the south comprised the southern boundary of the model. Calibration of the groundwater flow system was accomplished by adjusting the upgradient and downgradient constant-head values until the groundwater flow direction, lateral hydraulic gradients, and flow velocities approximated observed field values. Due to the small area simulated by the model, the relatively uniform lateral hydraulic gradient measured in the field, and the uniformity of hydraulic conductivity values estimated from slug tests at the site, a constant transmissivity [36 square feet per day (ft^2/day)] was used in the model. Recharge from annual precipitation was omitted because a portion of the site is covered with asphalt and buildings, which would minimize the infiltration of precipitation, and the ground surface in the remaining portion of the modeled area slopes steeply to the ditch, promoting runoff rather than infiltration. The omission of precipitation recharge contributes to the conservative nature of the model predictions, because the contaminant plume is not diluted by rain water. The model was calibrated under steady-state conditions.

Figure F.3 shows the calibrated water table. The simulated hydraulic gradient is 0.008 ft/ft, compared to measured gradients ranging from 0.006 to 0.009 ft/ft (CAP Section 3). Simulated groundwater velocities along the plume flowpaths between the former UST locations and the ditch ranged from 0.09 foot per day (ft/day) to 0.16 ft/day. This range compares favorably with velocities computed prior to the modeling

TABLE F.1
BIOPLUME II MODEL INPUT PARAMETERS
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

Parameter	Description	Calibrated Model Setup	Model Runs	
			MOGAS_1	MOGAS_2
NTIM	Maximum number of time steps in a pumping period	1	1	1
NPMP	Number of Pumping Periods	1	84	17
NX	Number of nodes in the X direction	20	20	20
NY	Number of nodes in the Y direction	30	30	30
NPMAX	Maximum number of Particles NPMAX=(NX-2)(NY-2)(NPTPND) + (Ns[a/])(NPTPND) + 250	5200	5200	5200
NPNT	Time step interval for printing data	1	1	1
NITP	Number of iteration parameters	7	7	7
NUMOBS	Number of observation points	0	0	0
ITMAX	Maximum allowable number of iterations in ADIP [b/]	200	200	200
NREC	Number of pumping or injection wells	50	50	50
NPTPND	Initial number of particles per node	9	9	9
NCODES	Number of node identification codes	1	1	1
NPNTMV	Particle movement interval (IMOV)	0	0	0
NPNTVL	Option for printing computed velocities	1	1	1
NPNTD	Option to print computed dispersion equation coefficients	0	1	1
NPDELC	Option to print computed changes in concentration	0	1	1
NPNCHV	Option to punch velocity data	0	0	0
NREACT	Option for biodegradation, retardation and decay	1	1	1
PINT	Pumping period (years)	10	[c/]	[c/]
TOL	Convergence criteria in ADIP	0.001	0.001	0.001
POROS	Effective porosity	0.25	0.25	0.25

TABLE F.1 (Continued)
BIOPLUME II MODEL INPUT PARAMETERS
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

			Model Runs	
Parameter	Description	Calibrated Model Setup	MOGAS_1	MOGAS_2
BETA	Characteristic length (long. dispersivity; feet)	10	10	10
S	Storage Coefficient	0 (Steady-State)	0	0
TIMX	Time increment multiplier for transient flow	-	-	-
TINIT	Size of initial time step (seconds)	-	-	-
XDEL	Width of finite difference cell in the x direction (feet)	14	14	14
YDEL	Width of finite difference cell in the y direction (feet)	16	16	16
DLTRAT	Ratio of transverse to longitudinal dispersivity	0.1	0.1	0.1
CELDIS	Maximum cell distance per particle move	0.5	0.5	0.5
ANFCTR	Ratio of Tyy to Txx (1 = isotropic)	1	1	1
DK	Distribution coefficient	0.049	0.049	0.049
RHOB	Bulk density of the solid (grams/cubic centimeter)	1.65	1.65	1.65
THALF	Half-life of the solute	-	-	-
DEC1	Biodegradation decay coefficient (day^{-1})	0.0004	0.0004	0.0004
DEC2	Reaeration coefficient (day^{-1})	-	-	-
F	Stoichiometric Ratio of Hydrocarbons to Oxygen	3.1	3.1	3.1

a/ Ns = Number of nodes that represent fluid sources (wells or constant head cells)

b/ ADIP = Alternating-direction implicit procedure (subroutine for solving groundwater flow equation)

c/ For model MOGAS_1, the first pumping period was 10 years long, and subsequent pumping periods were 2 to 3 years long. For model MOGAS_2, all pumping periods after the initial 10-year period were 1 year long.

LEGEND

- DRAINAGE DITCH WITH FLOW DIRECTION
- SANITARY SEWER
- STORM SEWER
- FENCE
- FORMER UST LOCATION
- MW-113 GROUNDWATER MONITORING WELL (INSTALLED 1988 OR 1994)
- MW-06 GROUNDWATER MONITORING WELL (INSTALLED 1995)
- MOC-11 GROUNDWATER MONITORING POINT
- AS-01 AIR SPARGING PILOT TEST WELL
- 15.3 LINE OF EQUAL SIMULATED GROUNDWATER ELEVATION (ft msl) CONTOUR INTERVAL = 0.3 FOOT
- GRASSY AREAS
- FORESTED AREAS
- ESTMATED GROUNDWATER FLOW DIRECTION

0 40 80 160
FEET

FIGURE F.3

CALIBRATED GROUNDWATER SURFACE

MOGAS Site Corrective Action Plan
Risk-Based Approach to Remediation
Myrtle Beach AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

K:\AFCEE\725522\96DN0663, 08/16/96 at 12:38

using site-specific hydraulic gradient and hydraulic conductivity data (0.09 to 0.13 ft/day).

In solving the groundwater flow equation, Bioplume II establishes the water table surface and calculates an overall hydraulic balance that accounts for the numerical difference between flux into and out of the system. The hydraulic mass balance for the calibrated model was excellent, with 99.61 percent of the water flux into and out of the system being numerically accounted for (i.e., a 0.39-percent error). According to Anderson and Woessner (1992), a mass balance error of around 1 percent is acceptable.

F4.2 Benzene Plume Calibration

After calibration of the flow model, the numerical transport model was calibrated. Because residual soil contamination could still act as a significant contaminant source at the site, model injection wells were included to simulate partitioning of benzene from the soil source into the groundwater. The number of contaminant injection wells that can be added to a Bioplume II model is limited to 50. However, the lateral extent of residual soil contamination depicted on CAP Figure 5.3 encompasses more than 50 model grid cells. Therefore, the leaching of benzene from soils into groundwater at this site was simulated by the addition to the model of 50 benzene injection wells that were located in the areas of most elevated soil contaminant concentrations. The locations of the injection wells are shown on Figure F.4.

While the term "injection well" suggests contaminants are being introduced at a point, Bioplume II assumes that contamination introduced at a well instantly equilibrates throughout the entire cell in which the well is located. The injection rate for the cells was set at 1.0×10^{-5} cubic foot per second (ft^3/sec), a value low enough that the flow calibration in the modeled area was not affected. The benzene plume was calibrated by altering benzene injection concentrations in a trial-and-error fashion until the simulated benzene plume approximated observed field values. During the calibration process, the model was run for a period of 10 years to achieve a steady-state plume that was not changing over time.

Figure F.5 shows the simulated 1995 dissolved benzene plume. The general geometry of the simulated plume closely resembles that of the observed plume (Figure F.1), and the simulated magnitude of benzene concentrations is similar to those measured in site groundwater samples. However, the simulated benzene concentrations in the area between the two UST locations are lower than those measured in the field. This difference is due to the lack of benzene injection wells in the model in this area. As described above, the Bioplume II model imposes a 50-well limit on injection wells, and the wells were clustered at and immediately south of the UST locations.

F5.0 DISCUSSION OF IMPORTANT PLUME CALIBRATION PARAMETERS

The only parameters varied during calibration of the benzene plume were the benzene injection concentrations, which were the variables that were known with the least degree of certainty. A reasonably conservative retardation coefficient was computed using site-specific total organic carbon (TOC) data, and the dispersivity and contaminant decay rate were derived from data collected at the adjacent POL area

FIGURE F.4

LOCATIONS OF SIMULATED BENZENE INJECTION WELLS

MOGAS Site Corrective Action Plan
Risk-Based Approach to Remediation
Myrtle Beach AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

K:\AFCEE\725522\96DN0664, 08/16/96 at 12:55

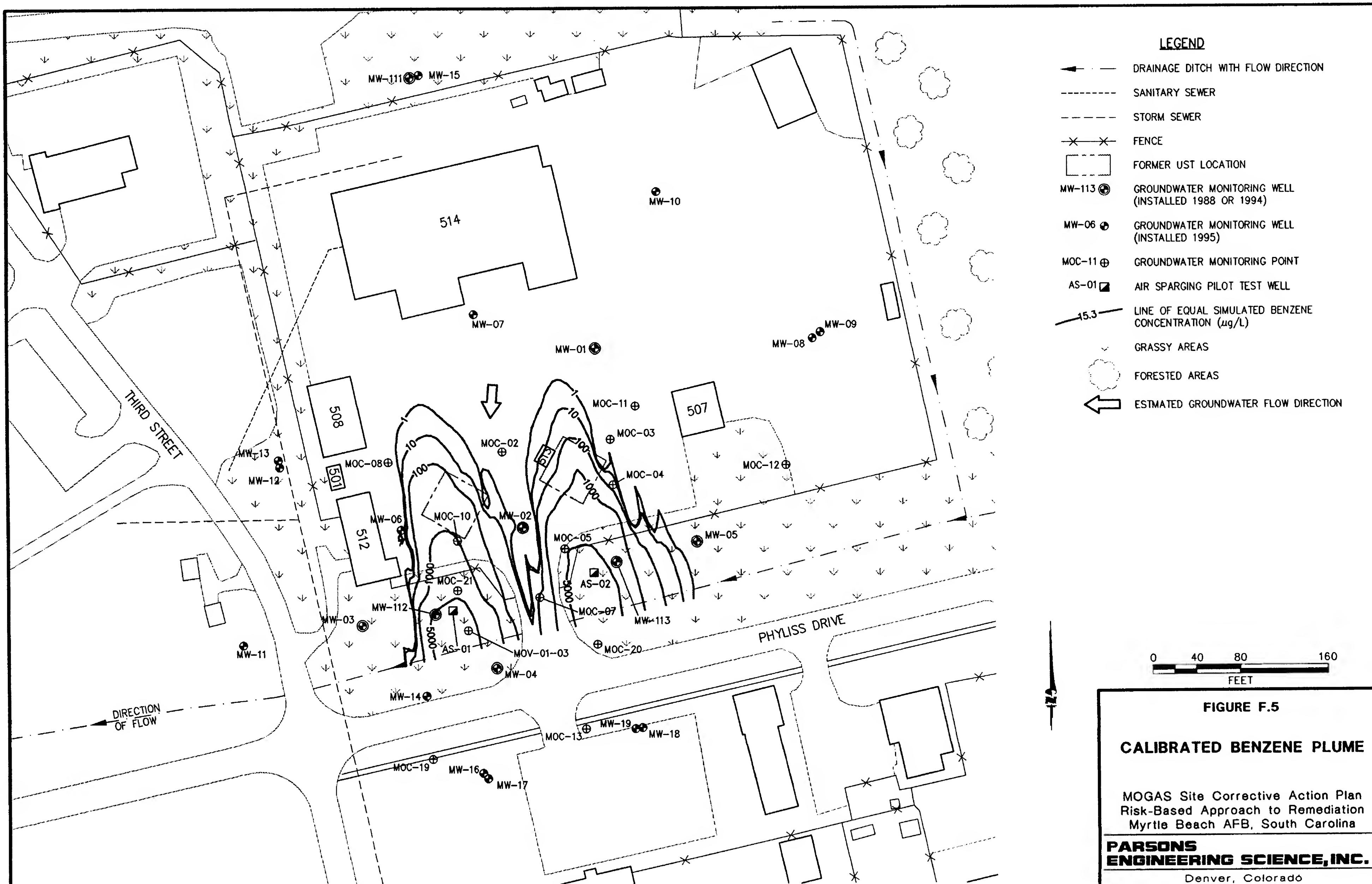


FIGURE F.5

CALIBRATED BENZENE PLUME

MOGAS Site Corrective Action Plan
Risk-Based Approach to Remediation
Myrtle Beach AFB, South Carolina

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

K:\AFCEE\725522\96DN0665, 08/20/96 at 15:55

(Parsons ES, 1995). The values used for the model parameters of dispersivity, retardation, contaminant decay rate, and contaminant injection concentrations are discussed below.

F5.1 Dispersivity

Much controversy surrounds the concepts of dispersion and dispersivity. Longitudinal dispersivity values for sediments similar to those found at the site range from 0.1 to 200 feet (Walton, 1988). Longitudinal dispersivity at the adjacent POL area was estimated to be 9.2 feet, which was the value used in the calibrated Bioplume II model constructed for that site. A nearly identical value of 10 feet was used in the MOGAS site model. The use of a low dispersivity value contributed to the conservative nature of the model because low dispersivities cause less contaminant mass to be lost to dispersion-related dilution. Transverse dispersivity values generally are estimated as one-tenth (0.1) of the longitudinal dispersivity values (Domenico and Schwartz, 1990); this ratio was maintained in the MOGAS site model.

F5.2 Coefficient of Retardation

Retardation of contaminants relative to the advective velocity of the groundwater occurs when contaminant molecules are sorbed to the aquifer matrix. A reasonable range of retardation coefficients for benzene was calculated based on measured TOC concentrations in the soils in and near the saturated zone at the site (CAP Section 3), an assumed bulk density of 1.65 grams per cubic centimeter (Freeze and Cherry, 1979), and a published value of the soil sorption coefficient (K_{oc}) for benzene, as listed by Wiedemeier *et al.* (1995). The results of these calculations are summarized in Table F.2. A final value of 1.33 for the benzene retardation coefficient was used in the model. This value, which implies that benzene is not significantly retarded during migration, is similar to the average retardation coefficient of 1.2 computed for all of the BTEX compounds for the adjacent POL area and used in the calibrated Bioplume II model constructed for that site. As with dispersivity, this variable was not adjusted in the model calibration. Large retardation coefficients slow contaminant migration and enhance the effectiveness of biodegradation processes.

F5.3 Contaminant Decay Coefficient

The contaminant decay coefficient is a first-order rate constant that can be used in Bioplume II to simulate aerobic and anaerobic contaminant removal. The contaminant decay coefficient (or biodegradation coefficient) is estimated with an analytical solution of the general one-dimensional transport equation modified by Buscheck and Alcantar (1995). A contaminant decay coefficient of 0.0004 day^{-1} was derived by the above method discussed above using data from the adjacent POL area. This value is low compared with values for benzene reported in the literature, which range from 0.001 to 0.03 day^{-1} (CAP Section 6). As with dispersivity and retardation, this area-specific value was not varied in the model calibration process.

TABLE F.2
CALCULATION OF RETARDATION COEFFICIENTS
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

Compound	K_{oc} (L/kg [a])	Maximum Fraction Organic Carbon [b]	Minimum Fraction Organic Carbon [b]	Average Fraction Organic Carbon [b]	Distribution Coefficient K_d (L/kg)			Bulk Density (kg/L) [d]	Effective Porosity	Coefficient of Retardation			Estimated Average Advective Groundwater Velocity [e] (ft/day)
					Maximum [c1]	Minimum [c2]	Average [c3]			Maximum	Minimum	Average	
Benzene	79	0.0025	0	0.00085	0.198	0.000	0.067	1.65	0.25	2.30	1.00	1.44	0.07
Toluene	190	0.0025	0	0.00085	0.475	0.000	0.162	1.65	0.25	4.14	1.00	2.07	0.05
Ethylbenzene	468	0.0025	0	0.00085	1.170	0.000	0.398	1.65	0.25	8.72	1.00	3.63	0.03
m-xylene	405	0.0025	0	0.00085	1.013	0.000	0.344	1.65	0.25	7.68	1.00	3.27	0.03
o-xylene	422	0.0025	0	0.00085	1.055	0.000	0.359	1.65	0.25	7.96	1.00	3.37	0.03
p-xylene	357	0.0025	0	0.00085	0.893	0.000	0.303	1.65	0.25	6.89	1.00	3.00	0.04
1,3,5-TMB	676	0.0025	0	0.00085	1.690	0.000	0.575	1.65	0.25	12.15	1.00	4.79	0.02
1,2,4-TMB	772	0.0025	0	0.00085	1.930	0.000	0.656	1.65	0.25	13.74	1.00	5.33	0.02
Naphthalene	927	0.0025	0	0.00085	2.318	0.000	0.788	1.65	0.25	16.30	1.00	6.20	0.02

NOTES:

[a] From technical protocol (Wiedemeier *et al.*, 1995).

[b] From MOGAS site data.

[c1] K_d = Maximum Fraction Organic Carbon x K_{oc}.

[c2] K_d = Minimum Fraction Organic Carbon x K_{oc}.

[c3] K_d = Average Fraction Organic Carbon x K_{oc}.

[d] Literature value.

[e] Velocity computed using average hydraulic parameters presented in Section 3 of the Corrective Action Plan.

k:\myrtle\tables\retard.xls

F6.0 PREDICTIVE SIMULATIONS

To predict the future fate and transport of dissolved benzene at the MOGAS site, two Bioplume II model simulations were performed. The first simulation, termed "MOGAS_1", assumed that the rate at which benzene was introduced into the aquifer geometrically decreased by 3 percent per year (injected benzene concentrations were decreased by 3 percent from the concentration used for the previous year to account for natural weathering of fuel residuals). The source decay rate includes the combined effects of volatilization, dissolution (i.e., leaching), and biodegradation on source area residual LNAPL and sorbed soil contamination. This weathering rate was derived by matching a geometrically decreasing contaminant source concentration to the soil leaching rate predicted using a the batch-flushing model. The batch-flushing model is described in CAP Section 6.6.1, and supporting calculations are provided at the end of this appendix. This model was run for a period of 200 years beyond 1995.

The second simulation, termed "MOGAS_2", assumes that all of the residual LNAPL in site soils is actively remediated via a combination of bioventing and biosparging within 3 years, at the end of which the source area is no longer contributing benzene to the groundwater. Bioventing and biosparging are *in situ* processes in which low-flow air injection is used to enhance the aerobic biodegradation of organic contaminants in vadose zone and saturated zone soils, respectively, by supplying oxygen to indigenous microbes. Biosparging also promotes volatilization of VOCs sorbed to saturated soils or dissolved in the groundwater. In this scenario, there is a 50-percent reduction in benzene source concentrations by the end of year 1, a 95-percent reduction by the end of year 2, and complete elimination of the benzene source term by the end of year 3.

In addition, the effects of a 64-foot-long air sparging curtain downgradient from each of the former UST locations near the drainage ditch was simulated in model MOGAS_2 by adding sufficient oxygen to the groundwater in each of 4 adjacent model cells to increase DO concentrations in each of these cells by 1.2 to 1.5 mg/L. These cells included (4,9), (4,10), (4.11), (4,12), (4,17), (4,18), (4,19), and (4,20). To determine the proper oxygen injection concentration, all benzene was removed from the model, and varying amounts of oxygen were added to each of the above cells until the steady-state DO concentrations increased above pre-sparging concentrations by 1.2 to 1.5 mg/L. Steady-state conditions were achieved by running the model, with oxygen injection, for 10 years. The objective of the air sparging curtain simulation was to assess the degree to which benzene discharge to the drainage ditch could be reduced. The air sparging curtain was "turned on" in model MOGAS_2 for a period of 9 years following 1997, and the model was run for a total of 16 years.

In press: Proceedings of the Battelle In Situ and On-Site Bioreclamation Symposium, April 24-27, 1995, San Diego, CA.

REGRESSION TECHNIQUES AND ANALYTICAL SOLUTIONS TO DEMONSTRATE INTRINSIC BIOREMEDIATION

Timothy E. Buscheck and Celia M. Alcantar
Chevron Research and Technology Company
Richmond, CA

ABSTRACT

It is now generally recognized that a major factor responsible for the attenuation and mass reduction of benzene, toluene, ethylbenzene, and xylenes (BTEX) in groundwater plumes is hydrocarbon biodegradation by indigenous microorganisms in aquifer material. Our objective is to apply well-known regression techniques and analytical solutions to estimate the contribution of advection, dispersion, sorption, and biodecay to the overall attenuation of petroleum hydrocarbons. These calculations yield an apparent biodecay rate based on field data. This biodecay rate is a significant portion of the overall attenuation in stable, dissolved hydrocarbon plumes.

INTRODUCTION

"Intrinsic bioremediation" is the degradation of organic compounds by indigenous microbes without artificial enhancement. Advection, dispersion, sorption, and decay each contribute to the overall attenuation of a dissolved hydrocarbon plume. The effect of advection is to transport dissolved contaminants at the same rate as the groundwater velocity. The effect of dispersion is to spread contaminant mass beyond the volume it would occupy due to advection alone, and reduce contaminant concentrations. The effect of sorption is to retard contaminant migration. These factors affect the configuration of dissolved hydrocarbon plumes. Overall attenuation can cause a plume to shrink over time, create a stable plume, or reduce the rate of plume migration. Two of the conditions for which intrinsic bioremediation is likely to contribute to the configuration of a contaminant plume are a shrinking plume and a stable plume. The configuration of a migrating plume can also be affected by intrinsic bioremediation. Under the conditions of a shrinking plume, degradation mechanisms are necessarily present. Intrinsic bioremediation also is likely to contribute to a stable plume, particularly if the source persists in residually contaminated soils at the water table. In this paper we couple the regression of concentration versus distance for stable plumes to an analytical solution for one-dimensional, steady-state, contaminant transport. The analytical solution includes advection, dispersion, sorption, and decay.

Biological transformation is the process that likely contributes most to the decay of compounds such as BTEX. Several studies suggest the concurrent loss of electron acceptors from groundwater as an indicator of biodegradation (McAllister and Chiang 1994, Salanitro 1993). The mechanism of biodegradation is complex, and the rate is most likely controlled by the mixing of the contaminant and electron acceptors in a three-dimensional, heterogeneous aquifer. The assumption of a first-order decay is a useful approximation of this complex phenomenon. Evaluation of site data suggests apparent first-order attenuation rates occur in the range of 0.1 to 1.0 % per day (Buscheck et al. 1993).

The objective of this paper is to provide tools to assist in documenting the loss of contaminants. The regression techniques and analytical solution described are intended to distinguish those mechanisms that contribute to contaminant loss.

PLUME CHARACTERISTICS

Shrinking Plume

Dissolved hydrocarbon plumes may decrease in size, as observed by declining contaminant concentrations in monitoring wells. Exponential regression methods can be used to evaluate whether concentration versus time data fit a first-order decay observed for petroleum hydrocarbons under certain conditions. The solution to the first-order decay is:

$$C(t) = C_i e^{-(kt)} \tag{1}$$

Where C(t) (M/L^3) is concentration as a function of time, t (T), C_i is the initial concentration at t = 0, and k is the first-order attenuation rate, T^{-1}. Equation (1) may be used to evaluate contaminant concentration versus time data for individual monitoring wells.

Stable Plume

A stable plume is characterized by dissolved contaminant concentrations remaining constant over time in individual monitoring wells. Short-term variations in monitoring well concentrations due to water table fluctuation, variability in groundwater flow direction, sampling variability, and analytical uncertainty should be distinguished from statistically significant concentration changes. In order for a plume to reach stable conditions, the rate of natural attenuation must be equal to the rate of contaminant addition to the aquifer from the source (McAllister and Chiang 1994). The contaminant source or influx rate is limited by the compound's effective solubility and the flow rate of water through the source area (infiltration, fluctuating water table, etc.).

Kemblowski et al. (1987) recast equation (1) for concentration as a function of distance:

$$C(x) = C_o e^{-(k\frac{x}{v_x})} \tag{2}$$

Where C_o (M/L^3) is the concentration at the source. The transformation of the exponential terms in equations (1) and (2) is achieved by substituting time, t, with distance traveled, x (L) divided by the linear groundwater velocity, v_x (L/T). The term "x/v_x" is the residence time for pore water to move some distance, x, from the source. The concentration versus distance regression is based on equation (2). The groundwater flow direction is defined based on multiple monitoring events covering the hydrologic cycle. Six monitoring wells were selected along the groundwater flow path (see inset of Figure 1). A minimum of three monitoring wells are required for this analysis. In this case, contaminant concentrations declined with downgradient distance. Figure 1 plots benzene concentration versus distance for a terminal in Fairfax, Virginia. From the exponent of equation (2), the slope of the line in Figure 1 is k/v_x (L^{-1}), the reciprocal of the attenuation distance. If this slope is multiplied by groundwater velocity (L/T), we obtain

k (T^{-1}). In the absence of a reliable estimate of groundwater velocity, the k/v_x term is useful, particularly for estimating the downgradient extent of contaminant migration and selecting downgradient monitoring well locations.

ANALYTICAL SOLUTION FOR A STABLE PLUME

The general one-dimensional transport equation, with first-order decay of the contaminant, is given by the following equation:

$$\frac{\delta C}{\delta t} = \frac{1}{R_f}\left[D_x \frac{\delta^2 C}{\delta x^2} - v_x \frac{\delta C}{\delta x}\right] - \lambda C \tag{3}$$

Where D_x (L^2/T) is the dispersion coefficient, v_x (L/T) is the linear groundwater velocity, R_f (-) is the retardation coefficient, and λ (T^{-1}) is the total decay rate. The form of equation (3) assumes D_x is constant and independent of distance, x. While the terms in brackets describe the mass transport by dispersion and advection, respectively, the retardation coefficient characterizes the contribution of sorption. The form of this equation assumes degradation occurs in the aqueous and sorbed phases at the same rate. If biological transformation of BTEX compounds occurs primarily in the aqueous phase, the term "λC" would appear inside the brackets.

Dispersion and advection are related by the longitudinal dispersivity, α_x (L), which has been described by empirical expressions (Fetter 1993).

$$D_x = \alpha_x v_x \tag{4}$$

The retardation coefficient (R_f) accounts for contaminant partitioning between the solid and aqueous phases. R_f describes the relationship between the linear groundwater velocity, and contaminant velocity, v_c (L/T):

$$R_f = \frac{v_x}{v_c} \tag{5}$$

Chiang et al. (1989) demonstrated that the contribution of volatilization to the dissolved contaminant attenuation was only 5% at one site. Except in the case of very shallow groundwater, volatilization is not expected to contribute significantly to the overall attenuation. Therefore, volatilization is neglected and the decay rate is assumed to be a measure of biodegradation of BTEX compounds.

Bear (1979) solved equation (3) for concentration. The steady-state solution is given as:

$$C(x) = C_o \exp\left[\left(\frac{x}{2\alpha_x}\right)\left[1 - \left(1 + \frac{4\lambda\alpha_x}{v_c}\right)^{\frac{1}{2}}\right]\right] \tag{6}$$

For the case in which decay occurs only in the aqueous phase, the contaminant velocity, v_c, is replaced by the linear groundwater velocity, v_x, in equation (6). As the decay rate (λ) increases with respect to the other transport mechanisms, the concentration away from the source (x > 0), approaches zero because the material is decaying at a greater rate than it is being transported through the medium. Similarly, as the contaminant velocity increases, the decay becomes less effective in reducing concentrations as a function

of distance. Retarded contaminants therefore have a greater opportunity to decay because retarded transport velocities favor biodegradation kinetics over transport (Domenico and Schwartz 1990).

The exponential regression for concentration versus distance yields the reciprocal of the attenuation distance, k/v_x (L^{-1}), previously shown in equation (2). Equations (2) and (6) are of the same form:

$$C(x) = C_o \exp(mx) \tag{7}$$

The slope of the log-linear data is given by m. The one-dimensional, steady-state transport solution also describes the slope, m, of the log-linear data:

$$m = \left(\frac{1}{2\alpha_x}\right)\left[1-\left(1+\frac{4\lambda\alpha_x}{v_c}\right)^{\frac{1}{2}}\right] \tag{8}$$

Therefore, the term k/v_x and equation (8) both describe the slope of the log-linear data and can be equated to solve for the total decay rate, λ, a measure of intrinsic bioremediation. Dispersivity (α), contaminant velocity (v_c), and k/v_x are input to the following equation to calculate the decay rate.

$$\lambda = \left(\frac{v_c}{4\alpha_x}\right)\left(\left[1+2\alpha_x\left(\frac{k}{v_x}\right)\right]^2 - 1\right) \tag{9}$$

For the case in which decay occurs only in the aqueous phase, v_c is replaced by v_x in equation (9).

RESULTS

The results of equating the spatial regression with the steady-state analytical solution for the Fairfax Terminal are presented in Table 1. The values for source concentration (C_o) and k/v_x were regressed using the data plotted in Figure 1. Table 1 includes k and the ratio, λ/k, the contribution of biodecay to the overall attenuation rate (expressed as %). In Case 1, groundwater velocity was 0.06 m/day, based on aquifer pump tests. Retardation was estimated as 2 and dispersivity was estimated as 7.5 m, approximately 5% of the flow field (distance separating the two furthest wells). In Case 1, λ = 0.30%/day (0.0030 $days^{-1}$); λ is 75% of k for this case. The next four cases were performed to evaluate the sensitivity of changing various input parameters. In each of these cases C_o and k/v_x remain constant. In Case 2, the groundwater velocity is reduced by a factor of two (v = 0.03 m/day), which reduces the decay rate by the same factor (λ = 0.15%/day). In this case, only half the decay rate is required to maintain the Case 1 concentration decline with distance; as in Case 1, λ is 75% of k in Case 2. In Case 3, the dispersivity is increased by a factor of two (α = 15 m) and λ = 0.40%/day. More decay is required with a larger dispersivity because more spreading of the contaminant occurs in the direction of groundwater flow; λ is equivalent to k in Case 3.

Cases 4 and 5 were performed to calculate λ assuming biodecay occurs only in the aqueous phase. This is accomplished by replacing v_c with v_x in equation (9) for λ (R = 1 in Table 1 for Cases 4 and 5). Given this revised formulation, the decay rate, λ, is independent of retardation. By limiting decay to the aqueous phase in Case 4, λ = 0.60%/day, twice the decay rate in Case 1. In Case 4, λ is 150% of k. Case 5 is similar to Case 4, but dispersivity is reduced to 0.3 m. In Case 5, λ = 0.40%/day. Less decay is required with a smaller dispersivity because less spreading of the contaminant plume occurs in the

direction of groundwater flow; λ and k are identical in Case 5.

SUMMARY

Contaminant decay is the primary process contributing to a stable configuration of a dissolved contaminant plume. Given a constant source, sorption and dispersion alone are not likely to account for a stable plume. Sorption only retards contaminant velocity, whereas dispersion results in further spreading of the contaminant, reducing concentrations. Decay (biodegradation of BTEX compounds) is the most significant mechanism that accounts for mass loss in a dissolved contaminant plume. The analytical solution for steady-state contaminant transport can be equated to a regression of concentration versus distance (expressed as k/v_x) to solve for the decay rate, λ. The decay rate is a measure of intrinsic bioremediation of petroleum hydrocarbons and can be used in more sophisticated models.

REFERENCES

Bear, J. 1979. Hydraulics of Groundwater. McGraw-Hill, New York, NY.

Buscheck, T. E., K. T. O'Reilly, and S. N. Nelson. 1993. "Evaluation of Intrinsic Bioremediation at Field Sites." Proceedings, Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, pp. 367-381. National Ground Water Association/API, Houston, TX.

Chiang, C. Y., J. P. Salanitro, E. Y. Chai, J. D. Colthart, and C. L. Klein. 1989. "Aerobic Biodegradation of Benzene, Toluene, and Xylene in a Sandy Aquifer - Data Analysis and Computer Modeling." Ground Water 27(6): 823-834.

Domenico, P. A. and F. W. Schwartz. 1990. Physical and Chemical Hydrogeology. John Wiley & Sons, New York, NY.

Fetter, C. W. 1993. Contaminant Hydrogeology. Macmillan Publishing Company, New York, NY.

Kemblowski, M. W., J. P. Salanitro, G. M. Deeley, and C. C. Stanley. 1987. "Fate and Transport of Residual Hydrocarbon in Groundwater - A Case Study." Proceedings, Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, pp. 207-231. National Water Well Association/API, Houston, TX.

McAllister, P. M. and C. Y. Chiang. 1994. "A Practical Approach to Evaluating Natural Attenuation of Contaminants in Ground Water." Ground Water Monitoring and Remediation 14(2): 161-173.

Salanitro, J. P. 1993. "The Role of Bioattenuation in the Management of Aromatic Hydrocarbon Plumes in Aquifers." Ground Water Monitoring and Remediation 13(4): 150-161.

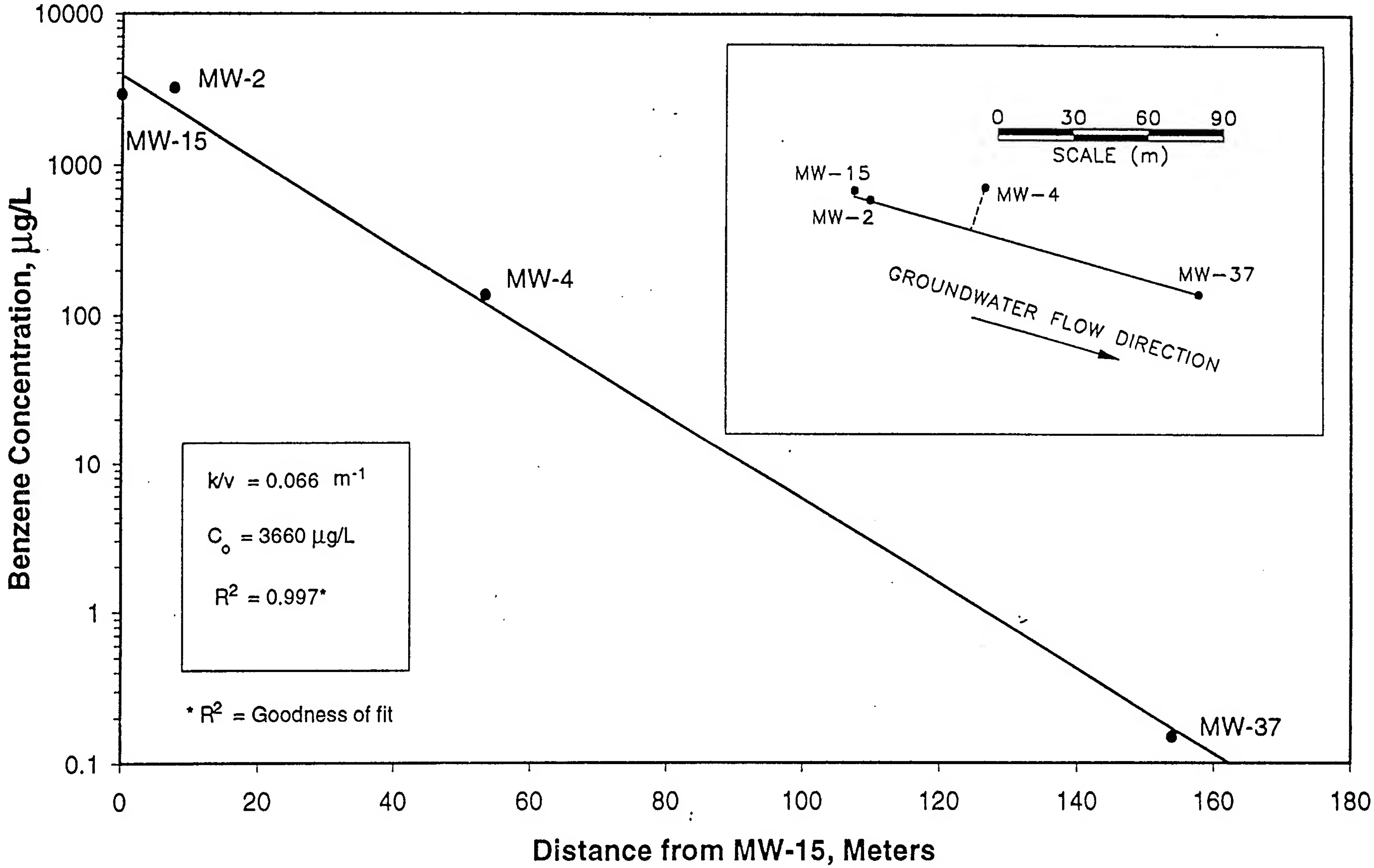


FIGURE 1. Exponential regression of concentration versus distance for Fairfax Terminal.

TABLE 1. Decay rates based on steady-state analytical solution, C_o = 3,660 μg/L, k/v_x = 0.066 m^{-1}. (sensitivity on bold input values)

Case	groundwater velocity, v_x (m/day)	retardation coefficient, R_f	contaminant velocity, v_c (m/day)	dispersivity, α (m)	attenuation rate, k (%/day)	decay rate, λ (%/day)	λ/k (%)
Case 1	0.06	2	0.03	7.5	0.40	0.30	75
Case 2	**0.03**	2	0.015	7.5	0.20	0.15	75
Case 3	0.06	2	0.03	**15**	0.40	0.40	100
Case 4	0.06	**1**(1)	0.06	7.5	0.40	0.60	150
Case 5	0.06	**1**(1)	0.06	**0.3**	0.40	0.40	100

Note: (1) Calculation of λ independent of v_c.

APPENDIX G

SITE-SPECIFIC TARGET LEVEL CONCENTRATIONS DERIVATIONS AND TOXICITY PROFILES

SITE-SPECIFIC TARGET LEVEL CONCENTRATIONS DERIVATIONS

APPENDIX G
SITE-SPECIFIC TARGET CONCENTRATIONS FOR GROUNDWATER-INCIDENTAL DERMAL EXPOSURE
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE AFB, SOUTH CAROLINA

Exposure Assumptions: Onsite Intrusive Workers

Parameters	RME	CT
ATc = Averaging Time for Carcinogens (dys)	25550	25550
ATn = Averaging Time for Noncarcinogens (dys)	365	183
BW = Body Weight (kg)	70	70
ED = Exposure Duration (yr)	1	1
EF = Exposure Frequency (dys/yr)	250	219
ET = Exposure Time (hrs/dy)	8	8
HQ = Target Hazard Quotient	1	1
PC = Permeability Constant (cm/hr)	chem-spec	chem-spec
RfDd = Dermal Reference Dose (mg/kg-dy)	chem-spec	chem-spec
SA = Skin Surface Area (cm^2)	5800	5000
SFd = Dermal Slope Factor (kg-day/mg)	chem-spec	chem-spec
TR = Target risk	1.00E-06	1.00E-06

Calculations

Carcinogenic Chemicals:
C = (TR * BW * ATc)/(ED * EF *(SA*10-3 L/cm3*ET*PC*SFd))

Noncarcinogenic Chemicals:
C = (HQ * BW * ATn*RfDd)/(ED * EF *SA*10-3 L/mc3*ET*PC)

Groundwater COPC	PC (cm/hr)	SFd (kg-dy/mg)	RfDd (mg/kg-dy)	Noncarcinogenic Site-Specific Target Concentration RME-Based Value (mg/L)	Noncarcinogenic Site-Specific Target Concentration CT-Based Value (mg/L)	Carcinogenic Site-Specific Target Concentration RME-Based Value (mg/L)	Carcinogenic Site-Specific Target Concentration CT-Based Value (mg/L)
Benzene	2.10E-02	3.05E-02	-	-	-	2.41E-01	3.19E-01
Ethylbenzene	7.40E-02	-	8.50E-02	2.53E+00	3.35E+00	-	-
Toluene	4.50E-02	-	1.80E-01	8.81E+00	1.17E+01	-	-
Xylenes	8.00E-02	-	1.80E+00	4.96E+01	6.56E+01	-	-
Naphthalene	6.90E-02	-	8.00E-03	2.55E-01	3.38E-01	-	-
1,2,4,-Trimethylbenzene	1.38E-01	-	4.50E-02	7.18E-01	9.51E-01	-	-
1,3,5-Trimethylbenzene	1.38E-01	-	4.50E-02	7.18E-01	9.51E-01	-	-

K:\MYRTLE\TABLES\GWSSTLS.XLS

APPENDIX G
SITE-SPECIFIC TARGET CONCENTRATIONS FOR SURFACE WATER - INCIDENTAL DERMAL EXPOSURE AND INCIDENTAL INGESTION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE AFB, SOUTH CAROLINA

Exposure Assumptions: Onsite Recreator-Child/Adult

Parameters	RME	CT
ATc = Averaging Time for Carcinogens (dys)	25550	25550
BW = Body Weight (kg)	44	44
ED = Exposure Duration (yr)	9	6
EF = Exposure Frequency (dys/yr)	90	40
ET = Exposure Time (hrs/dy)	2.6	2.6
SA = Skin Surface Area (cm^2)	6100	5400
SFd = Dermal Slope Factor (kg-day/mg)	chem-spec	chem-spec
SFo = Oral Slope Factor (kg-day/mg)	chem-spec	chem-spec
IR = Ingestion Rate (L/hr)	0.05	0.05
PC = Dermal Permeability (cm/hr)	chem-spec	chem-spec
TR = Target risk	1.00E-06	1.00E-06

Carcinogenic Chemicals:

C = (TR * BW * ATc)/(ED * EF *ET*[(IR*SFo)+(SA*PC*0.001*SFd)])

COPC	PC (cm/hr)	SFo (kg-dy/mg)	SFd (kg-dy/mg)	Carcinogenic Site-Specific Target Concentration RME-Based Value (mg/L)	CT-Based Value (mg/L)
Benzene	2.10E-02	2.90E-02	3.05E-02	9.96E-02	3.67E-01

k:\myrtle\tables\sstl.xls(swdermng)

APPENDIX G
SITE-SPECIFIC TARGET CONCENTRATIONS FOR SEDIMENT-INCIDENTAL DERMAL EXPOSURE
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE AFB, SOUTH CAROLINA

Exposure Assumptions: Onsite Recreator-Child/Adult

Parameters	RME	CT
ATc = Averaging Time for Carcinogens (dys)	25550	25550
BW = Body Weight (kg)	44	44
ED = Exposure Duration (yr)	9	9
EF = Exposure Frequency (dys/yr)	100	60
HQ = Target Hazard Quotient	1	1
ABS = Absorption Factor	2.50E-01	2.50E-01
AF = Soil-Skin Adherance ($mg/cm^2/day$)	1	0.2
SA = Skin Surface Area (cm^2)	6100	5400
SFd = Dermal Slope Factor (kg-day/mg)	chem-spec	chem-spec
TR = Target risk	1.00E-06	1.00E-06

Carcinogenic Chemicals:
C = (TR * BW * ATc)/(ED * EF *AF*SA*1E-6kg/mg*ABS*SFd)

		Carcinogenic Site-Specific Target Concentration	
COPC	SFd (kg-dy/mg)	RME-Based Value (mg/kg)	CT-Based Value (mg/kg)
Benzene	3.05E-02	2.69E+01	2.53E+02

k:\myrtle\tables\sstl.xls{sddermal}

PARSONS ENGINEERING SCIENCE, INC.

Client AFCEE | Job No. 725522.04000 | Sheet 1 of 1

Subject Myrtle Beach CAP | By SH | Date

Soil Leaching Model + SSTL Calcs. | Checked | Rev.

The following batch flush model uses site specific Kd values for COPCs and % availabilities to help establish conservative soil and soil leaching (gw protective) site specific target levels (SSTLs)

% availabilities were calculated by comparing observed maximum COPC concentrations with calculated COPC concentrati[ons] (using site specific Kd's)

$$C_{observed} = C_{calculated} * \% \text{ available}$$

$$\% \text{ available} = \frac{C_{observed}}{C_{calculated}}$$

% availability of a COPC, to leach into groundwater, includes parameters not used when calculating Cmax using just site specific Kds. This % availability includes

1) Amount of contaminant at groundwater/soil ~~pore~~ interface; amount available for leaching
2) Modifies the sorption value (Kd) to a desorption value, which is what is actually occurring during leaching.
3) Relates pore volume COPC concentration to actual obser[ved] groundwater concentration

These calculations are conservative because as COPC concentrations increase in soil, there is still a finite amount that is at the soil-groundwater interface available to desorb into the groundwater. This allows soil leaching to occur for a longer time period, making clean-up times longer and therefore clean-up criteria more conservative to prevent long term soil to groundwater contamination problems.

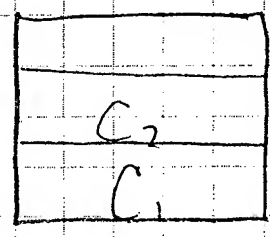
PARSONS ENGINEERING SCIENCE, INC.

Client: AFCEE — Job No. 725522.04000 — Sheet 1 of 5

Subject: Myrtle Beach CAP — By: SH — Date:

Batch Flush Model + SSTLs — Checked: SAB — Rev. Ø

Conceptual model



$\uparrow C_w = \frac{m_1 + m_2}{V_1 + V_2}$ ← not used

$\uparrow C_{w_1} = \frac{m}{V_1}$

GW velocity = .13 ft/day

$\rho = 1.7$

$\phi = 0.3$

Mass soil / Mass gw

$$\left(0.3 \frac{cm^3\, H_2O}{cm^3\, soil}\right)\left(\frac{cm^3\ soil}{1.7\,g}\right) = 0.176\ mL/kg$$

MW112

Assimilative Capacity: ↓ 64300 (april '94) → 47300 (aug/sep '95)

~ 25% ↓ in mass over 518 day

≈ decay rate =

$.75 = e^{-k(518)}$

$\ln .75 = -k(518)$

$k = 5.55 \times 10^{-4}$ /day

1/2 life

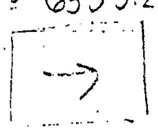
$.5 = e^{-(5.55 \times 10^{-4})t}$

$\ln .5 = -5.55 \times 10^{-4}(t)$

$t = 1248.9$ days

$t_{1/2} = 3.42$ years × 2 $\boxed{6.8\ yrs}$

215 = 6553.2 cm



plume length

Flush time of contaminated area = 1/GW velocity * plume length

Flush rate = (1/(.13 ft/day [illegible])) * 6553.2 cm

= $\boxed{4.53\ years}$

PARSONS ENGINEERING SCIENCE, INC.

Client AFCEE | Job No. 725522.04000 | Sheet 2 of 5
Subject Myrtle Beach CAP | By SH | Date
Checked JAB | Rev. Ø

Calculating Kds

$$Kd = \frac{C_{soil}}{C_{water}} \quad \text{or} \quad Kd = K_{oc} * f_{oc}$$

	GW MW06	Soil (15-17) MW06	Kd
Benzene	32	5.4	.169 ⇒ .19
Ethylb	1.9	1.1 J	.579
Toluene	2.4	9.1	3.79
Xylene	2.3	4.15	1.78

	Koc	foc	Kd
Napth =	933-1288	.0014	1.80
Chloro =	83-389	.0014	.545
135 =	676	.0014	.947

$$\boxed{C_{wat} = \frac{C_{soil}}{Kd} * \%\text{avail to leach / dilution}}$$

$$C_{soil\,res.} = \left(C_{soil\,initial} - \left[C_{water\,leached} * .176\right]\right)$$

$$\boxed{C_{wat\,after\,1\,flush} = \frac{C_{soil\,res}}{Kd} * \%\text{ avail.}}$$

% available – found by calculating suspected concentration in groundwater using soil concentration and site specific Kd, then comparing calculated and observed groundwater concentrations a % availability factor was calculated.

	% avail
Benzene –	1%
Toluene	1.3%
Ethylbenzene	8.4%
Napthalene	3.6%
Chlorobenzene	0.058%
1,3,5-Trimethyl	0.22%

PARSONS ENGINEERING SCIENCE, INC.

Client AFCEE	Job No. 725522.04000	Sheet 3 of 5
Subject Myrtle Beach CAP	By SH	Date
	Checked [illegible]	Rev. Ø

Calculating SSTL to Tier I

$$C_{soil}\,(\text{target}) = \frac{K_d\, C_{water}}{\%\ \text{available}}$$

Benzene - .36 ug/L

$$C_{soil}(\text{protective of GW}) = \frac{.36 * .19}{.01092} = 6.26\ \text{ug/kg}$$

Toluene - 750 ug/L

$$C_{soil}(\text{protective}) = \frac{750 * 3.79}{.01341} = 1071\ \text{ug/kg}$$

Ethylbenzene - 700 ug/L

$$C_{soil}(\text{protective}) = \frac{700 * .579}{.083779} = 4837\ \text{ug/kg}$$

Naphthalene - 25 ug/L

$$C_{soil}(\text{protective}) = \frac{25 * 1.80}{.03678} = 1223\ \text{ug/kg}$$

Chlorobenzene = 39 ug/L

$$C_{soil}(\text{protective}) = \frac{39 * .545}{.00058} = 36{,}646\ \text{ug/kg}$$

135 TMB = 300 ug/L

$$C_{soil}(\text{protective}) = \frac{300 * .947}{.002195} = 129430\ \text{ug/kg}$$

PARSONS ENGINEERING SCIENCE, INC.

Client AFCEE   Job No. 725522.04000   Sheet 4 of 5

Subject Myrtle Beach CAP   By SH   Date

Checked ANB   Rev. Ø

Calculating [Soil] p of gw to Tier 2 RME SSTL

B = 241 ug/L

C_{soil}(protective) = $\frac{241 * .19}{.01092}$ = 4193 ug/kg

T = 8,810 ug/L

C_{soil}(protective) = $\frac{8,810 * 3.79}{.01341}$ = 2,489,925 ug/kg

E = 2530 ug/L

$C_{soil}(p)$ = $\frac{2530 * .579}{.083779}$ = 17,485 ug/kg

Nap = 255 ug/L

$C_{soil}(p)$ = $\frac{255 * 1.80}{.03678}$ = 12,480 ug/kg

Chloro = 320 ug/L

$C_{soil}(p)$ = $\frac{320 * .545}{.00058}$ = 300,690 ug/kg

135 = 718 ug/L

$C_{soil}(p)$ = $\frac{718 * .947}{.002195}$ = 309,770 ug/kg

Gw concentrations are from Appendix G, Groundwater - Incidental dermal exposure SSTL table

PESI-COR-8 (12/94)

PARSONS ENGINEERING SCIENCE, INC.

Client: AFCEE | Job No. 725522.04000 | Sheet 5 of 5

Subject: Myrtle Beach CAP | By: SA | Date:

Checked: ØRB | Rev. Ø

Calculation [Soil] protective of GW to Tier 2 CT SSTL

B = 319 ug/L

$$C_{soil}(p) = \frac{319 * .19}{.01092} = 5{,}550 \text{ ug/kg}$$

T = 11,700 ug/L

$$C_{soil}(p) = \frac{11700 * 3.79}{.01341} = 3{,}306{,}711 \text{ ug/kg}$$

E = 3,350 ug/L

$$C_{soil}(p) = \frac{3{,}350 * .579}{.083779} = 23{,}152 \text{ ug/kg}$$

N = 338 ug/L

$$C_{soil}(p) = \frac{338 * 1.80}{.03678} = 16{,}542 \text{ ug/kg}$$

Chloro = 430 ug/L

$$C_{soil}(p) = \frac{430 * .545}{.00058} = 404{,}052 \text{ ug/kg}$$

135 = 951 ug/L

$$C_{soil}(p) = \frac{951 * .947}{.002195} = 410{,}295 \text{ ug/kg}$$

GW concentrations (ug/L) are from Appendix Co SSTL table for groundwater residential dermal exposure

PESI COR-8 (12/94)

TOXICITY PROFILES

BENZENE

CAS NUMBER

71-43-2

COMMON SYNONYMS

None noted.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 1,791 mg/L [1]
Vapor Pressure: 95.19 mm Hg at 25°C [1]
Henry's Law Constant: 5.43 x 10^{-3} atm-m^3/mole [1]
Specific Gravity: 0.879 at 15/5°C [2]
Organic Carbon Partition Coefficient: 31 - 143 [1]

FATE DATA: HALF-LIVES

Soil: 5 - 16 days [3]
Air: 2.09 - 20.9 days [3]
Surface Water: 5 - 16 days [3]
Groundwater: 10 days to 2 years [3]

NATURAL SOURCES

Crude oil, volcanoes, forest fires, and plants [1].

ARTIFICIAL SOURCES

Gasoline, fuel oils, chemical industry, coke ovens, mining, manufacturing, and cigarette smoke [1].

FATE AND TRANSPORT

Benzene will rapidly volatilize from surface soil and water. That which does not volatilize from permeable surface and subsurface soils will be highly to very highly mobile, and can be expected to leach to nearby groundwater which is not protected by a confining layer. It is fairly soluble, and will be carried with the groundwater to discharge points. It may be subject to biodegradation in soils, shallow groundwater, and surface water. Benzene will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms, or hydrolyze. Photodegradation may be a significant removal mechanism in surface water which is not conducive to microbial degradation. Benzene will undergo significant photodegradation in air, but may be washed out with rain [1].

HUMAN TOXICITY

General. Benzene is absorbed into the body following ingestion, inhalation, and dermal contact, and must undergo metabolic transformation to exert its toxic effects. Metabolism occurs primarily in the liver, and to a lesser extent, in the bone marrow [4]. The primary targets of benzene toxicity are the CNS and the blood [4,5]. Benzene is genotoxic to humans and the USEPA has placed it in weight-of-evidence cancer group A, indicating that it is a human carcinogen [6].

Oral Exposure. A chronic oral RfD for benzene is currently under review by the USEPA [6]. Benzene is readily absorbed following oral exposure. The lowest reported fatal dose in humans is 50 mg/kg [5]. Acute oral LD_{50} values in animals include 930 to 5600 mg/kg in rats, 2000 mg/kg in dogs, and 4700 mg/kg in mice [4,5]. Data regarding the ingestion of benzene in humans are limited to acute overexposure. Ingestion of 2 mL (29 mg/kg) has resulted in depression of the CNS, while ingestion of 10 mL (143 mg/kg) has been fatal [5]. The cause of death was usually respiratory arrest, CNS depression, or cardiac collapse [4]. In animals, longer-term oral exposure has resulted in toxic effects on the blood (cytopenia: decrease in various cellular elements of the blood) and the immunological system (decreased white blood cells) [4]. There is no evidence that oral exposure to benzene causes effects on reproduction and development, but studies in animals suggest that benzene may affect fetal development [4]. There is no information regarding carcinogenic effects in humans following oral exposure to benzene, but studies in animals indicate that benzene ingestion causes cancer in various regions of the body [4]. An oral slope factor of 0.029 $(mg/kg\text{-}day)^{-1}$ is based on an increase in the incidence of leukemia in occupationally-exposed workers [6]. The oral slope factor was extrapolated from the inhalation data.

Inhalation Exposure. A chronic inhalation RfC for benzene is currently under review by the USEPA [6]. Benzene is readily absorbed following inhalation exposure. The lowest reported fatal concentration in humans is 6380 mg/m^3 for a 5 minute exposure [5]. Acute inhalation LC_{50} values in rats ranged from 10,000 ppm for 7 hours to 13,700 ppm for 4 hours [4,5]. Most of the available data regarding benzene exposure involve workers exposed in the workplace. The acute effects of benzene exposure involve the CNS. Brief exposure to concentrations of 700 to 3000 ppm can cause drowsiness, dizziness, headaches, and unconsciousness, and exposure to concentrations of 10,000 to 20,000 ppm can result in death [4]. In most cases, the effects will end when exposure ceases. The hematopoietic system is the primary target of toxicity following long-term exposure: exposure for several months to years results in pancytopenia (reduction in red blood cells, platelets, and white blood cells), while continued exposure for many years results in anemia or leukemia. The lowest concentration resulting in the hematological effects is approximately 10 to 50 ppm [5]. Benzene has been shown to cause chromosomal aberrations in bone marrow and lymphocytes in workers exposed to concentrations >100 ppm [5]. Chromosomal damage has been found in animals at concentrations as low as 1 ppm [5]. Benzene is not known to be teratogenic (cause birth defects) in humans, but has been found to cause various problems in the developing fetus of animals (low birth weight and delayed bone formation) [4,5]. Occupational exposure to benzene has resulted in leukemia in exposed workers [4,5]. An inhalation unit risk of 8.3×10^{-6} $(ug/m^3)^{-1}$ is based on the incidence of leukemia in occupationally-exposed workers [6].

Dermal Exposure. Dermal exposure to benzene may cause redness and dermatitis [4,5]. Systemic effects have not been reported following dermal exposure to benzene.

REFERENCES

1. Howard, P.H., 1990. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Vol. II: Solvents. Lewis Publishers, Inc. Chelsea, Michigan. 546 pp.

2. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

3. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

4. ATSDR, 1991. Toxicological Profile for Benzene (Draft). Agency for Toxic Substances and Disease Registry. USPHS/USEPA. October 1991.

5. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 2. Cambridge, MA. July 1989.

6. USEPA, 1995. Integrated Risk Information System (IRIS). Database. Online.

TOLUENE

CAS NUMBER

108-43-2

COMMON SYNONYMS

Methylbenzene.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 534.8 mg/L at 25°C [1]
Vapor Pressure: 28.4 mm Hg at 25°C [1]
Henry's Law Constant: 5.94×10^{-3} atm-m^3/mole (temperature not given) [1]
Specific Gravity: 0.866 at 20/4°C [2]
Organic Carbon Partition Coefficient: 37 to 178 [1]

FATE DATA: HALF-LIVES

Soil: 4 to 22 days [3]
Air: 10 hours to 4.3 days [3]
Surface Water: 4 to 22 days [3]
Groundwater: 1 to 4 weeks [3]

NATURAL SOURCES

Volcanoes, forest fires, and crude oil [1].

ARTIFICIAL SOURCES

Gasoline, fuel oils, automobile exhaust, chemical industry, and paints and lacquers [1].

FATE AND TRANSPORT

Much of the toluene released to surface soil will be lost due to volatilization. It is mobile in soils and will leach to groundwater. Biodegradation occurs slowly in soil and groundwater, but is inhibited by high concentrations. Under ideal conditions of low concentration and acclimated microbial populations, rapid biodegradation may occur. Losses from surface water occur due to volatilization and biodegradation. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. In the atmosphere it will degrade or be washed out with rain [1].

HUMAN TOXICITY

General. Toluene acts primarily on the central nervous system [4]. The USEPA has placed toluene in weight-of-evidence group D; indicating that it is not classifiable as to human carcinogenicity [5].

Oral Exposure. A chronic RfD of 0.2 mg/kg-day is based on a NOAEL of 223 mg/kg-day for changes in liver and kidney weights in a subchronic oral study in rats. The LOAEL in this study was a dose of 446 mg/kg-day [5]. Toluene is absorbed more slowly from the gastrointestinal tract than from the lungs [6]. The acute oral LD_{50} for adult rats is in the range of 5,000 to 7,300 mg/kg [4,6]. Brain damage was noted in mice receiving 1,250 mg/kg-day by gavage for 13 weeks [6].

Inhalation Exposure. The RfC of 0.4 mg/m^3 is based on a LOAEL of 88 ppm for CNS effects observed in humans following inhalation exposure [5]. Toluene is rapidly absorbed following inhalation by humans and animals [6]. The inhalation LC_{50} in mice is 5,300 ppm for an 8-hour exposure. Exposure of humans by inhalation to 200 ppm for 8 hours produced mild fatigue, weakness, confusion, lacrimation, and tingling of the skin. At 600 ppm, additional effects included euphoria, headache, dizziness, dilated pupils, convulsions, and nausea. After 8 hours at 800 ppm, symptoms were more pronounced; effects included nervousness, muscular fatigue, and insomnia persisting for several days. Exposure to concentrations of 10,000 to 30,000 ppm could lead to narcosis and death. Chronic abusive inhalation of toluene vapors by humans produces CNS impairment, and emotional and intellectual disturbances. Uptake in the various brain regions is widespread due to the high lipid solubility of toluene and the high lipid content of the brain. Effects on animals following high levels of exposure include hearing loss, kidney effects, and lung lesions. High level oral intake by animals has resulted in weight increases in the liver and kidney, and brain tissue damage [4].

Dermal Exposure. The absorption of toluene through human skin is slow, falling within the range of 14 to 23 mg/cm^2/hour. Dermal contact with toluene by humans may cause skin damage. Application of toluene to the eyes of rabbits reportedly resulted in moderately severe injury [6].

REFERENCES

1. Howard, P.H., 1990. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Vol. II: Solvents. Lewis Publishers, Inc. Chelsea, Michigan. 546 pp.

2. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

3. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

4. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 2. Cambridge, MA. July 1989.

5. USEPA, 1995. Integrated Risk Information System (IRIS). Online. Database.

6. ATSDR, 1989. Toxicological Profile for Toluene. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1989.

ETHYLBENZENE

CAS NUMBER

100-41-4

COMMON SYNONYMS

None noted.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 161 mg/L at 25°C [1]
Vapor Pressure: 9.53 mm Hg at 25°C [1]
Henry's Law Constant: 8.44 x 10^{-3} atm-m^3/mole [1]
Specific Gravity: 0.87 at 25/25°C [2]
Organic Carbon Partition Coefficient: 871 [1]

FATE DATA: HALF-LIVES

Soil: 3 to 10 days [3]
Air: 8.56 hours to 3.57 days [3]
Surface Water: 3 to 10 days [3]
Groundwater: 6 to 228 days [3]

NATURAL SOURCES

Coal tar and petroleum [4].

ARTIFICIAL SOURCES

Manufacture of styrene, solvent, petroleum refining, vaporization/spills of gasoline and diesel fuel, auto emissions, paints, inks, insecticides, and cigarette smoke [1,2,4].

FATE AND TRANSPORT

Ethylbenzene released to surface soils will probably undergo partial volatilization and, given its limited ability to sorb to soils (K_{oc} = 871), leach to groundwater. Evidence suggests that this material undergoes biodegradation in groundwater, and may also do so in soils if the initial loading doesn't prove toxic to soil-based microorganisms. If released to surface waters, ethylbenzene is expected to volatilize fairly readily. As with groundwater, rapid biodegradation can be predicted after an initial acclimation period. Ethylbenzene shows only a slight to moderate tendency to adsorb to soils and sediments in water. Bioconcentration in aquatic organisms is not expected to be significant (BCF = 145). Ethylbenzene is expected to exist in the atmosphere primarily as a vapor, based upon its vapor pressure value (9.53 mm Hg). Principally, ethylbenzene will be

removed from the atmosphere via reaction with hydroxyl radicals; some washout via rainfall may be expected [1].

HUMAN TOXICITY

General. Humans exposed to ethylbenzene may experience eye and throat irritation, decreased movement, and dizziness. Studies in animals have shown liver and kidney damage, nervous system changes, and blood changes [4]. The USEPA has placed ethylbenzene in weight-of-evidence group D, indicating that it is not classifiable as to human carcinogenicity [5].

Oral Exposure. A chronic RfD of 0.1 mg/kg-day is based on a NOEL of 97.1 mg/kg-day and a LOAEL of 291 mg/kg-day determined for liver and kidney toxicity in a rat subchronic to chronic oral bioassay [5]. Studies in animals revealed that ethylbenzene is quickly and effectively absorbed following oral exposure. The oral (gavage) LD_{50} in rats is reported to be 4,728 mg/kg. No information was located regarding death or health effects in humans following oral exposure [4].

Inhalation Exposure. The RfC of 1 mg/m^3 is based on a NOAEL of 434 mg/m^3 determined for developmental toxicity in rats and rabbits exposed via inhalation [5]. Ethylbenzene is rapidly and efficiently absorbed via inhalation in humans and animals. A 4-hour LC_{50} of 4,000 ppm was reported for rats. Exposure-related adverse effects in animals included those to the liver and kidneys, eye irritation, profuse lacrimation, CNS depression, and ataxia. No deaths were reported for humans following inhalation of ethylbenzene. The effects observed in humans included pulmonary and ocular irritation, profuse lacrimation, chest constriction, dizziness, vertigo, and possible hematological alterations. Exposure of pregnant rats to levels above 138 ppm for 24 hours/day for 9 days had adverse developmental effects [4].

Dermal Exposure. Liquid ethylbenzene is rapidly absorbed through the skin; however, absorption of vapors through the skin is minimal. The dermal LD_{50} in rabbits for liquid ethylbenzene was reportedly 15,415 mg/kg. Ethylbenzene appears to be a slight eye irritant in rabbits [4].

REFERENCES

1. Howard, P.H., 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume I: Large Production and Priority Pollutants. Lewis Publishers, Inc. Chelsea, MI. 574 pp.

2. Merck, 1989. The Merck Index, Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

3. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers, Inc. Chelsea, MI. 725 pp.

4. ATSDR, 1990. Toxicological Profile for Ethylbenzene. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1990.

5. USEPA, 1995. Integrated Risk Information System (IRIS). Online Database.

XYLENES

CAS NUMBER

1330-20-7

COMMON SYNONYMS

Xylene.

Note: There are three isomers (forms) of xylene: ortho, meta, and para, also known as 1,2-, 1,3-, and 1,4-xylene, respectively.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 146 - 175 mg/L at 25°C [1]
Vapor Pressure: 6.6 - 8.7 mm Hg at 25°C [1]
Henry's Law Constant: 5.1×10^{-3} to 7.7×10^{-3} atm-m^3/mole at 25°C [2]
Specific Gravity: 0.880 at 20/4°C (*o*-xylene) [3]
Organic Carbon Partition Coefficient: 25.4 - 204 [1]

FATE DATA: HALF-LIVES

Soil: 1 - 4 weeks [4]
Air: 2.6 hours - 1.8 days [4]
Surface Water: 1 - 4 weeks [4]
Groundwater: 2 weeks - 1 year [4]

NATURAL SOURCES

All three isomers of xylene occur in petroleum. 1,2-Xylene is found additionally in coal tar, forest fire products, and plants [1].

ARTIFICIAL SOURCES

Gasoline, fuel oils, and their combustion products. Petroleum refining, chemical industry; aerosols of paints, varnishes, and shellacs. Wood-burning stoves and fireplaces [1].

FATE AND TRANSPORT

Xylenes are moderately mobile in soil and may leach to groundwater where they are known to persist for several years despite evidence of biodegradation in both soil and groundwater. The dominant removal process in surface water is volatilization, but this

is not a rapid process. Some adsorption to sediment will occur. Once released to the atmosphere, xylenes will undergo photochemical degradation at a moderate rate [1].

HUMAN TOXICITY

General. The primary target of xylenes toxicity is the central nervous system [2,5]. Xylenes are considered to be nongenotoxic. The USEPA has placed xylenes in weight-of-evidence cancer group D, indicating that they are not classifiable as to human carcinogenicity [6].

Oral Exposure. A chronic oral RfD of 2 mg/kg-day is based on a NOAEL of 250 mg/kg-day for hyperactivity, decreased body weight and increased male mortality in a chronic study in rats [6]. Acute oral LD_{50} values for xylenes ranged from 3523 to 8600 mg/kg in rats and 5251 to 5627 mg/kg in mice [2,5]. Death in humans has been reported following the ingestion of xylenes, but the fatal dose is not known [2]. Reports of the ingestion of xylenes in humans are generally lacking. In animals, oral exposure to xylenes results in effects on the liver (increased liver enzymes and weight), the kidenys (increased kidney weight), and the nervous system (impairment of visual function and hyperactivity) [4]. Information is not available regarding the effects of ingested xylene on reproduction or development in humans, and the results of developmental studies in animals are inconclusive [2]. There is no conclusive evidence that oral exposure to xylenes causes cancer in humans or animals, therefore, an oral slope factor is not available [6].

Inhalation Exposure. An inhalation RfC for mixed xylenes is considered non-verifiable by the USEPA [7]. Xylenes are readily absorbed following inhalation exposure. Acute inhalation LC_{50} values of 6350 to 6700 ppm (4-hour exposure) were reported in rats for mixed xylenes [2]. LC_{50} values for the separate isomers are comparable to the mixture. Cause of death was usually respiratory failure and/or sudden ventricular fibrillation. In humans, inhalation of approximately 10,000 ppm xylenes has been fatal [2]. Exposure of humans to 90 ppm xylene has produced impairment of reaction time, manual coordination and body balance [5]. Brief exposure to concentrations of 200 ppm has caused irritation of the eyes, nose, and throat, and exposure to concentrations above 200 ppm has resulted in nausea, vomiting, abdominal pain, and loss of appetite [5]. Long-term, high-level, occupational exposure to xylenes (>200 ppm) has resulted in CNS effects, incoordination, nausea, vomiting, and abdominal pain [5]. Studies in laboratory animals suggest that xylenes have a relatively low chronic toxicity. Some data in animals suggest possible kidney and liver impairment with high level inhalation exposures (>1000 ppm) [5]. Information regarding the effects of xylenes on human reproduction and development are not available, but teratogenicity, fetotoxicity, and maternal toxicity have been observed in animals [2,5]. Xylenes have been found to cross the human placenta, therefore, there is sufficient reason for concern for pregnant women who are exposed to xylenes [2,5]. It is not known whether inhaled xylenes cause cancer in humans or animals, therefore, an inhalation unit risk is not available [6].

Dermal Exposure. Acute dermal LD_{50} values in rabbits of 14.1 ml/kg and greater than 5.0 ml/kg are reported for m-xylene and mixed xylenes, respectively [5]. Xylene is a skin irritant and causes redness, defatting, and dryness. Vesicles may form following prolonged skin contact [2,5].

REFERENCES

1. Howard, P.H., 1990. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Vol. II: Solvents. Lewis Publishers, Inc. Chelsea, Michigan. 546 pp.

2. ATSDR, 1990. Toxicological Profile for Total Xylenes. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1990.

3. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

4. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

5. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 2. Cambridge, MA. July 1989.

6. USEPA, 1995. Integrated Risk Information system (IRIS). Data base. Online.

7. USEPA, 1994. Health Effects Assessment Summary Tables (HEAST). Office of Emergency and Remedial Response. OHEA ECAO-CIN-909. March, 1994.

CHLOROBENZENE

CAS NUMBER

108-90-7

COMMON SYNONYMS

Monochlorobenzene, Benzene chloride.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 471.7 mg/L at 25°C [2]
Vapor Pressure: 11.9 mm Hg at 25°C [2]
Henry's Law Constant: 3.45×10^{-3} atm-m^3/mole [2]
Specific Gravity: 1.11 at 20/4°C [1]
Organic Carbon Partition Coefficient: 83 to 389 [2]

FATE DATA: HALF-LIVES

Soil: 68 to 150 days [3]
Air: 3.0 to 30.4 days [3]
Surface Water: 68 to 150 days [3]
Groundwater: 136 to 300 days [3]

NATURAL SOURCES

None noted.

ARTIFICIAL SOURCES

Manufacture of pesticides (i.e., aniline and DDT), phenol; degreaser; solvent; and a heat transfer medium [1,2].

FATE AND TRANSPORT

Chlorobenzene released to moist soils will volatilize fairly readily. Releases to sandy or dry soils, however, can be expected to leach to groundwater. Once in groundwater, chlorobenzene will undergo slow biodegradation to 2-chlorophenol and/or 4-chlorophenol (among others). If released to surface water, the primary removal mechanism will be volatilization. Biodegradation of this material will occur in surface water; rapidity increases with increasing temperature and decreasing salinity. Chlorobenzene is not expected to bioconcentrate at significant levels among most aquatic species, although the BCF of 447 observed in fathead minnows indicates bioconcentratibility in select species. The K_{oc} value suggests only slight to moderate adsorptive tendencies to soils and sediments in water. Chlorobenzene is expected to exist almost entirely in the vapor phase in the atmosphere. The dominant mechanism

for removal of chlorobenzene from the atmosphere is reaction with hydroxyl radicals, with the resultant production of chlorophenols. Reaction with nitrous oxides (in polluted air) may also occur, with the production of chloronitrobenzenes and chloronitrophenols. Photolysis may occur, but at a rate much slower than previously discussed atmospheric reactions [2].

HUMAN TOXICITY

General. People exposed to chlorobenzene have experienced headaches, numbness, sleepiness, nausea, and vomiting. Chlorobenzene has been shown to affect the brain, liver, and kidneys in animals [4]. The USEPA has placed chlorobenzene in weight-of-evidence group D, indicating that it is not classifiable as to human carcinogenicity [5].

Oral Exposure. A chronic RfD of 0.02 mg/kg-day is based on a NOAEL of 19 mg/kg-day and a LOAEL of 54 mg/kg-day determined for histopathologic changes in the liver following subchronic oral (capsule) administration to dogs [5]. The limited data available indicates that chlorobenzene is absorbed from the gastrointestinal tract. A single human subject was found to absorb at least 31% of an administered dose, while rats were found to absorb at least 18% of an administered dose. A single dose of 4,000 mg/kg caused death in rats. A dose rate of 1,000 mg/kg-day for 14 days was lethal to all rats tested. Liver and kidney damage has been noted in animals following oral exposure. There is little information on oral exposures in humans. One case was reported of a 2-year-old child who ingested 5 to 10 mL of chlorobenzene, and became unconscious, cyanotic, and had muscle spasms. The child recovered uneventfully [4]. The dose in the latter case can be estimated at approximately 344 to 688 mg/kg.

Inhalation Exposure. A chronic RfC of 0.02 mg/m^3 is based on a LOAEL of 75 ppm determined for liver and kidney effects in a subchronic rat inhalation study [6]. Chlorobenzene is absorbed via inhalation in humans and animals. Humans exposed to 0.5 to 0.84 ppm were found to absorb between 38% and 45% of the administered dose. Exposure to a concentration of 200 mg/m^3 chlorobenzene for 2 hours was lethal to all mice tested. Rabbits died 2 weeks after exposure to a concentration of approximately 2.5 mg/m^3. Some adverse effects on the liver and kidney in animals were noted. Little information was available regarding the health effects of chlorobenzene in humans following inhalation exposure. Humans occupationally exposed for up to 2 years displayed signs of neurotoxicity including numbness, cyanosis, hyperesthesia, and muscle spasms [4].

Dermal Exposure. No information was located regarding dermal exposure to chlorobenzene in humans or animals [4].

REFERENCES

1. Merck, 1989. The Merck Index, Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

2. Howard, P.H., 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume 1: Large Production and Priority Pollutants. Lewis Publishers, Inc. Chelsea, MI. 574 pp.

3. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers, Inc. Chelsea, MI. 725 pp.

4. ATSDR, 1990. Toxicological Profile for Chlorobenzene. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1990.

5. USEPA, 1995. Integrated Risk Information System (IRIS). On-line data base.

6. USEPA, 1994. Health Effects Assessment Summary Tables (HEAST). Office of Emergency and Remedial Response. OHEA ECAO-CIN-909. March 1994.

NAPHTHALENE
2-METHYLNAPHTHALENE

GENERAL

There is relatively little information available on 2-methylnaphthalene as compared to naphthalene. Therefore, all information below refers to naphthalene unless explicitly stated otherwise.

CAS NUMBERS

Naphthalene	91-20-3
2-Methylnaphthalene	91-57-6

COMMON SYNONYMS

Naphthalene: Naphthene, Tar Camphor.
2-Methylnaphthalene: Beta-methylnaphthalene

ANALYTICAL CLASSIFICATION

Semivolatile organic.

PHYSICAL AND CHEMICAL DATA

	Naphthalene	2-Methylnaphthalene
Water Solubility (mg/L at 20°C) [1]	31.7	NA
Vapor Pressure (mm Hg at 25°C) [1]	0.087	NA
Henry's Law Constant (atm-m^3/mole) [1]	4.6×10^{-4}	NA
Specific Gravity (20/4°C) [1]	1.145	1.0058
Organic Carbon Partition Coefficient [1]	933	NA

FATE DATA: HALF-LIVES (HRS)

Soil: 16.6 to 48 days [2]
Air: 2.96 to 29.6 hours [2]
Surface Water: 12 hours to 20 days [2]
Groundwater: 1 to 288 days [2]

NATURAL SOURCES

Crude oil; and natural and uncontrolled combustion (i.e., forest fires) [3,4].

ARTIFICIAL SOURCES

Naphthalene: Petroleum refining, mothball use and manufacture, coal tar distillation, pitch fumes, chemical intermediate (i.e., phthalic anhydride manufacture), vehicle

emissions, combustion processes (i.e., refuse combustion), tobacco smoke, and oil spillage [3,4].

2-Methylnaphthalene: Synthesis of organic compounds such as insecticides, and releases from gasoline due to its use as an additive [1,5].

FATE AND TRANSPORT

Naphthalene's sorption to soil ranges from low to moderate, depending upon the organic carbon content of the soil, and will leach rapidly through sandy soils. Volatilization from the uppermost soil layer will be important, but will lessen in importance with soil depth. In addition, volatilization from moisture-saturated soil is not expected to be important. Biodegradation is expected to be rapid in soils previously contacted with other polycyclic aromatic hydrocarbons (PAHs), but slow in "virgin" soils [3].

Volatilization, photolysis, sorption (to suspended solids, sediments, etc.), and biodegradation are the primary removal mechanisms for naphthalene in waters. The actual predominant mechanisms change with variations in several factors (i.e., water flow rate, level of sediments/suspended soils, water clarity, etc.) In addition, biodegradation rates of naphthalene in water vary with changes in concentration of naphthalene (higher concentrations yield higher rates), "virgin" versus oil-polluted water (quicker in oil-polluted waters), actual pollution site (more rapid biodegradation in sediments than waters), aerobic versus anaerobic conditions (no biodegradation in anaerobic conditions), and so on. Bioconcentration in aquatic organisms is expected to be moderate, except for accelerated bioconcentration in organisms lacking an aryl hydroxylase enzyme system (i.e. phytoplankton, snails, and mussels). Naphthalene in the atmosphere reacts during daylight hours with hydroxyl radicals, and during nighttime hours with nitrate radicals. Photolysis is also expected to occur in the atmosphere [3].

HUMAN TOXICITY

General. The breakdown of red blood cells is the primary health concern for humans exposed to naphthalene. Human deaths following ingestion have occurred [1]. The USEPA has placed naphthalene in weight-of-evidence group D, indicating that it is not classifiable as to human carcinogenicity [6]. The USEPA does not currently provide any toxicity values for 2-methylnaphthalene [7,8].

Oral Exposure. Both the chronic and subchronic RfDs for naphthalene of 0.04 mg/kg-day are based on a NOEL of 50 mg/kg-day for decreased body weight observed in a subchronic oral (gavage) study in rats [7]. Clinical evidence indicates that naphthalene is absorbed by humans in significant quantities via the oral exposure route. The oral LD_{50} reported for naphthalene in rats ranges from 2,200 to 2,400 mg/kg in rats [1]. The oral LD_{50} reported for 2-methylnaphthalene in rats is 1,630 mg/kg [5]. Lethal doses of naphthalene in humans have ranged from as low as 74 mg/kg to as high as 574 mg/kg [1,8]. Ocular damage has been documented in humans and animals following oral exposure [1]. Symptoms of intoxication include: nausea, vomiting, headache, diaphoresis, hematuria, hemolytic anemia, fever, CNS depression, hepatic

necrosis, jaundice, convulsions, and coma [1,2,9]. Administration of 300 mg/kg-day to pregnant mice resulted in a decrease in the number of live pups per litter [1].

Inhalation Exposure. An inhalation RfC was not reported for naphthalene [6,7]. Clinical reports suggest that inhaled naphthalene may be absorbed in sufficient quantity to produce adverse health effects in humans; however, no quantitative absorption data were located for humans or animals. One study reported a NOAEL of 78 ppm for a 4-hour exposure for rats. Symptoms and effects of inhalation exposure in humans include: headache, nausea, vomiting, abdominal pain, malaise, confusion, anemia, jaundice, and renal disease. No information was found regarding developmental and reproductive effects [1].

Dermal Exposure. Limited evidence in human infants indicate that hemolytic anemia may have resulted from dermal exposure to an unknown quantity of naphthalene. A NOAEL of 2,500 mg/kg was reported for rats. Naphthalene is a mild dermal and ocular irritant [1].

REFERENCES

1. ATSDR, 1990. Toxicological Profile for Naphthalene and 2-Methylnaphthalene. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1990.

2. Howard, P.H.; Boethling, R.S.; Jarvis, W.F.; Meylan, W.M.; and Michalenko, E.M.; 1991. Handbook of Environmental Degradation Rates. Lewis Publishers, Inc. Chelsea, MI. 725 pp.

3. Howard, P.H., 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. I: Large Production and Priority Pollutants. Lewis Publishers, Inc. Chelsea, MI. 574 pp.

4. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

5. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 4. Cambridge, MA. July 1989.

6. USEPA, 1995. Integrated Risk Information System (IRIS). Online. Database.

7. USEPA, 1994. Health Effects Assessment Summary Tables (HEAST). Office of Emergency and Remedial Response. OHEA ECAO-CIN-821. March 1994.

8. National Institute for Occupation Safety and Health, 1991. Registry of Toxic Effects of Chemical Substances (RTECS), Volume I-III. United States Department of Health and Human Services. Cincinnati, OH.

1,2,4-TRIMETHYLBENZENE

CAS NUMBER

95-63-6

COMMON SYNONYMS

Pseudocumene.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: Insoluble
Vapor Pressure: NA
Henry's Law Constant: 5×10^{-3} atm-m^3/mole [1]
Specific Gravity: 0.8761 at 20°C [1]
Organic Carbon Partition Coefficient: 2150 [1]

FATE DATA: HALF-LIVES

Soil: NA
Air: NA
Surface Water: NA
Groundwater: NA

NATURAL SOURCES

Naturally occurring in coal tar and petroleum products [1].

ARTIFICIAL SOURCES

Used in the manufacture of dyes, perfumes, and resins; used as a solvent and paint thinner [1].

FATE AND TRANSPORT

No information was found regarding the fate and transport of 1,2,4-trimethylbenzene (1,2,4-TMB).

HUMAN TOXICITY

General. The relevant routes of exposure to 1,2,4-TMB are via inhalation and potentially dermal contact. The CNS, respiratory system, and the liver are the primary targets of 1,2,4-TMB toxicity [1].

Oral Exposure. A chronic RfD for 1,2,4-TMB is currently not available from the USEPA [1]. Information regarding toxic effects in humans or animals following oral exposure to 1,2,4-TMB are not available [1].

Inhalation Exposure. A chronic inhalation RfC for 1,2,4-TMB is currently not available from the USEPA [1]. Information regarding toxic effects in humans or animals following inhalation exposure to 1,2,4-TMB are not available [1].

Dermal Exposure. 1,2,4-TMB is a known skin irritant [1]. No other information was located regarding dermal exposure to 1,2,4-TMB in humans or animals [1].

REFERENCES

1. USEPA, 1996. Hazardous Substance Data Base (HSDB). Online. Database.

1,3,5-TRIMETHYLBENZENE

CAS NUMBER

108-67-8

COMMON SYNONYMS

Mesitylene.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: Insoluble
Vapor Pressure: 1.86 mm Hg at 20°C [1]
Henry's Law Constant: 5 x 10^{-3} atm-m^3/mole [1]
Specific Gravity: 0.8637 at 20°C [1]
Organic Carbon Partition Coefficient: 2150 [1]

FATE DATA: HALF-LIVES

Soil: NA
Air: NA
Surface Water: NA
Groundwater: NA

NATURAL SOURCES

Naturally occurring in coal tar and petroleum crudes [1].

ARTIFICIAL SOURCES

Used as a dyestuff intermediate, solvent, and paint thinner [1].

FATE AND TRANSPORT

No information was found regarding the fate and transport of 1,3,5-trimethylbenzene (1,3,5-TMB).

HUMAN TOXICITY

General. The relevant routes of exposure to 1,3,5-TMB are via inhalation and potentially dermal contact. The skin and lungs are the primary targets of 1,3,5-TMB toxicity [1].

Oral Exposure. A chronic RfD for 1,3,5-TMB is currently not available from the USEPA [1]. Information regarding toxic effects in humans and animals following oral exposure to 1,3,5-TMB are not available [1].

Inhalation Exposure. A chronic RfC for 1,3,5-TMB is currently not available from the USEPA [1]. Information regarding toxic effects in humans or animals following inhalation exposure to 1,3,5-TMB are not available [1].

Dermal Exposure. 1,3,5-TMB is a known skin irritant [1]. No other information was located regarding dermal exposure to 1,3,5-TMB in humans or animals [1].

REFERENCES

1. USEPA, 1996. Hazardous Substance Data Base (HSDB). Online. Database.

APPENDIX H

SOURCE REDUCTION TECHNOLOGY PILOT-TEST

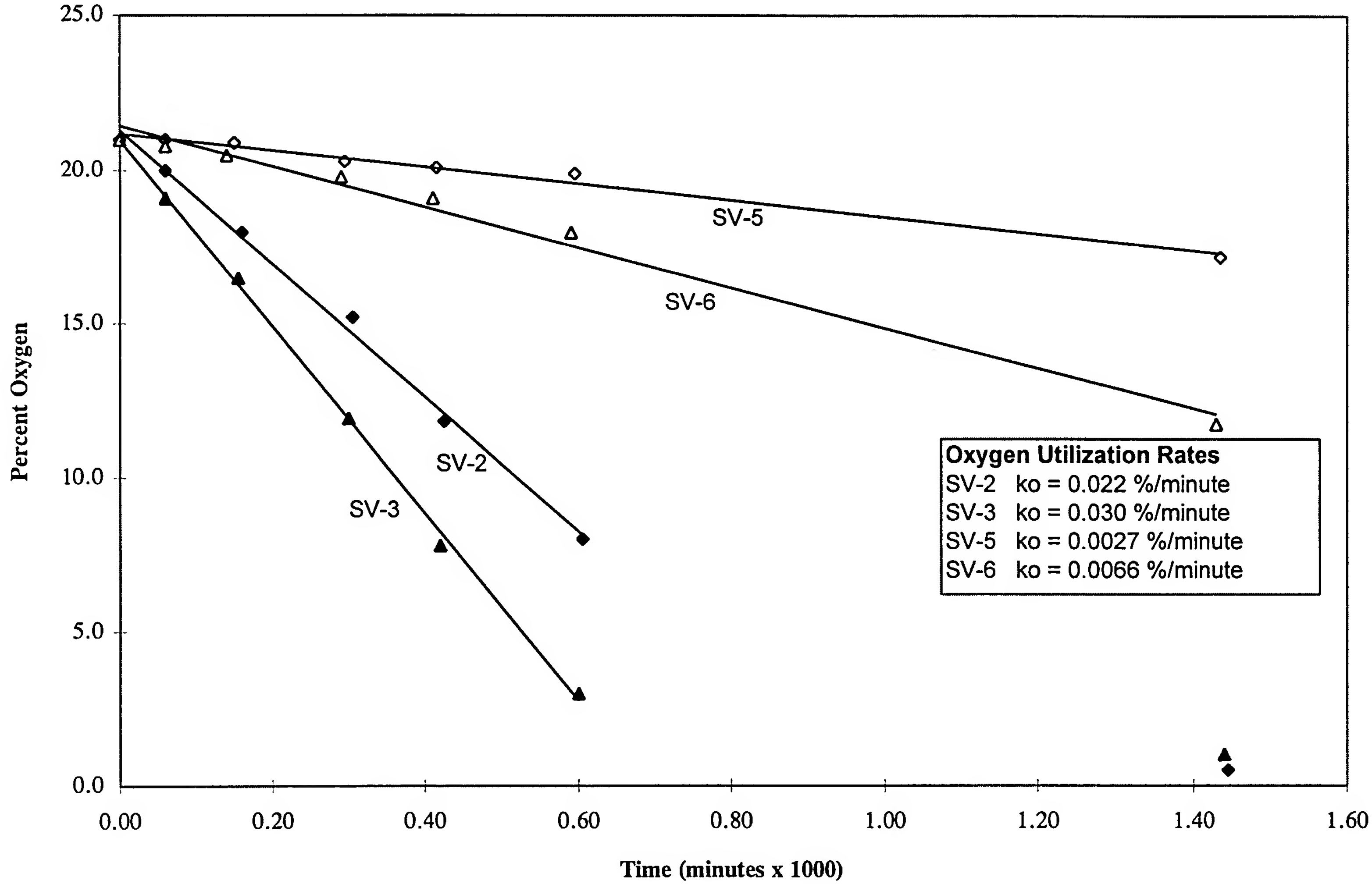
DATA AND CALCULATIONS

Initial Respiration Test
MOGAS Site
Myrtle Beach AFB, South Carolina

Monitoring Point	Date	Days Elapsed (frac. days)	Time	Hrs elapsed (fractional days)	Days Elapsed	Elapsed Time (min. x 1000)	O2%	CO2	Total Hydro-carbon	Comments	Trend of O2/ Time	New x-values	k
SV-2	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	50		21.3113166	0	0.021780
SV-2	11/15/95	0.00	09:30	0.04	0.04	0.06	20.0	0.0	86		8.02551678	0.61	
SV-2	11/15/95	0.00	11:10	0.11	0.11	0.16	18.0	0.1	160				
SV-2	11/15/95	0.00	13:35	0.21	0.21	0.31	15.2	0.4	200				
SV-2	11/15/95	0.00	15:35	0.30	0.30	0.43	11.8	0.7	230				
SV-2	11/15/95	0.00	18:35	0.42	0.42	0.61	8.0	1.0	280				
SV-2	11/16/95	1.00	08:35	0.00	1.00	1.45	0.5	1.8	400				
SV-3	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	60		20.9880575	0	0.030377
SV-3	11/15/95	0.00	09:30	0.04	0.04	0.06	19.1	0.0	170		2.76199436	0.6	
SV-3	11/15/95	0.00	11:05	0.11	0.11	0.16	16.5	0.1	250				
SV-3	11/15/95	0.00	13:30	0.21	0.21	0.30	11.9	0.5	360				
SV-3	11/15/95	0.00	15:30	0.29	0.29	0.42	7.8	0.7	620				
SV-3	11/15/95	0.00	18:30	0.42	0.42	0.60	3.0	1.1	620				
SV-3	11/16/95	1.00	08:30	0.00	1.00	1.44	1.0	1.8	760				
SV-5	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	44		21.1925474	0	0.002694
SV-5	11/15/95	0.00	09:30	0.04	0.04	0.06	21.0	0.0	200		17.3129278	1.44	
SV-5	11/15/95	0.00	11:00	0.10	0.10	0.15	20.9	0.1	270				
SV-5	11/15/95	0.00	13:25	0.20	0.20	0.30	20.3	0.3	390				
SV-5	11/15/95	0.00	15:25	0.29	0.29	0.42	20.1	0.5	500				
SV-5	11/15/95	0.00	18:25	0.41	0.41	0.60	19.9	0.7	540				
SV-5	11/16/95	1.00	08:25	0.00	1.00	1.44	17.2	0.9	960				
SV-6	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	540		21.4501911	0	0.006593
SV-6	11/15/95	0.00	09:30	0.04	0.04	0.06	20.8	0.0	680		12.02231	1.43	
SV-6	11/15/95	0.00	10:50	0.10	0.10	0.14	20.5	0.3	900				
SV-6	11/15/95	0.00	13:20	0.20	0.20	0.29	19.8	0.3	1,500				
SV-6	11/15/95	0.00	15:20	0.28	0.28	0.41	19.1	0.5	2,000				
SV-6	11/15/95	0.00	18:20	0.41	0.41	0.59	18.0	0.7	2,400				
SV-6	11/16/95	1.00	08:20	-0.01	0.99	1.43	11.7	0.9	5,000				

Gray areas - denote data points not included in ko calculation

Initial Respiration Results
MOGAS Site
Myrtle Beach AFB, SC



EXTENDED TESTING DATA SHEET
AFCEE BIOVENTING

Base Myrtle Bch AFB, SC
Site MOGAS SITE

Sampler(s) S. Archabal
Date 11/15/95 - 11/16/95
Test Type INITIAL ~~(6 month)~~ ~~(1 year)~~

INITIAL SOIL GAS CHEMISTRY

Monitoring Point	CO_2 (%)	O_2 (%)	TVH (ppm)	Temperature (F)	Comments
SV-2	10.0	0.0	10,000		INITIAL Readings PRIOR TO AIR Inject.
0830	0.0	21.0	50		INITIAL Following AIR INJECTION
0930	0.0	20.0	86		
1110	0.1	18.0	160		
1335	0.4	15.2	200		
1535	0.7	11.8	230		
1835	1.0	8.0	280		
0835	1.8	0.5	400		

INITIAL
11/15/95
11/16/95

BLOWER PERFORMANCE

Vacuum 1 (" H_2O)	Vacuum 2 (" H_2O)	Pressure (" H_2O)	Temperature (F)	Flow Rate (cfm)	Comments

SOIL SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Comments

SOIL GAS SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Canister Number

EXTENDED TESTING DATA SHEET
AFCEE BIOVENTING

Base Myrtle Bch AFB, SC
Site MOGAS SITE

Sampler(s) S. ARCHABAL
Date 11/15/95 – 11/16/95
Test Type INITIAL ~~(6 month)~~ ~~(1 year)~~

INITIAL SOIL GAS CHEMISTRY

11/15/95

11/16/95

Monitoring Point	CO_2 (%)	O_2 (%)	TVH (ppm)	Temperature (F)	Comments
SV-3	12.0	0.0	11,500		INITIAL PRIOR TO AIR INJECTION
0830	0.0	21.0	60		INITIAL FOLLOWING AIR INJECTION
0930	0.0	19.1	170		
1105	0.1	16.5	250		
1330	0.5	11.9	360		
1530	0.7	7.8	620		
1830	1.1	3.0	620		
0830	1.8	1.0	760		

BLOWER PERFORMANCE

Vacuum 1 ("H_2O)	Vacuum 2 ("H_2O)	Pressure ("H_2O)	Temperature (F)	Flow Rate (cfm)	Comments

SOIL SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Comments

SOIL GAS SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Canister Number

EXTENDED TESTING DATA SHEET
AFCEE BIOVENTING

Base: Myrtle Bch AFB, SC
Site: MOGAS SITE

Sampler(s): S. ARCHABAL
Date: 11/15/95 - 11/16/95
Test Type: ~~(6 month)~~ ~~(1 year)~~ INITIAL

INITIAL SOIL GAS CHEMISTRY

11/15/95

11/16/95

Monitoring Point	CO_2 (%)	O_2 (%)	TVH (ppm)	Temperature (F)	Comments
SV-5	9.2	5.5	12,000		INITIAL PRIOR TO AIR INJECTION *
0830	0.0	21.0	44		INITIAL FOLLOWING AIR INJECTION
0930	0.0	21.0	200		
1100	0.1	20.9	270		
1325	0.3	20.3	390		
1525	0.5	20.1	500		
1825	0.7	19.9	540		
0825	0.9	17.2	960		

BLOWER PERFORMANCE

Vacuum 1 (" H_2O)	Vacuum 2 (" H_2O)	Pressure (" H_2O)	Temperature (F)	Flow Rate (cfm)	Comments

SOIL SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Comments

SOIL GAS SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Canister Number

EXTENDED TESTING DATA SHEET
AFCEE BIOVENTING

Base Myrtle Bch AFB, SC
Site MOGAS SITE

Sampler(s) S. ARCHABAL
Date 11/15/95 – 11/16/95
Test Type ~~(6 month)~~ ~~(1 year)~~
INITIAL

INITIAL SOIL GAS CHEMISTRY

Monitoring Point	CO_2 (%)	O_2 (%)	TVH (ppm)	Temperature (F)	Comments
SV-6	11.9	0.0	>20,000		INITIAL PRIOR TO AIR INJECTION
0830	0.0	21.0	540		INITIAL following AIR INJECTION
0930	0.0	20.8	680		
1050	0.3	20.5	900		
1320	0.3	19.8	1,500		
1520	0.5	19.1	2,000		
1820	0.7	18.0	2,400		
0820	0.9	11.7	5,000		

11/15/95
11/16/95

BLOWER PERFORMANCE

Vacuum 1 ("H_2O)	Vacuum 2 ("H_2O)	Pressure ("H_2O)	Temperature (F)	Flow Rate (cfm)	Comments

SOIL SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Comments

SOIL GAS SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Canister Number

EXTENDED TESTING DATA SHEET
AFCEE BIOVENTING

Base Myrtle Bch AFB, SC
Site MOGAS SITE

Sampler(s) S. ARCHABAL
Date 11/15/95
Test Type ~~(6 month)~~ ~~(1 year)~~
INITIAL

INITIAL SOIL GAS CHEMISTRY

Monitoring Point	CO_2 (%)	O_2 (%)	TVH (ppm)	Temperature (F)	Comments
SV-7	3.8	10.5	3,000		INITIAL PRIOR to AIR INJECTION ☆

BLOWER PERFORMANCE

Vacuum 1 (" H_2O)	Vacuum 2 (" H_2O)	Pressure (" H_2O)	Temperature (F)	Flow Rate (cfm)	Comments

SOIL SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Comments

SOIL GAS SAMPLES

Monitoring Point	Depth (feet)	Sample Number	Date	Time	Canister Number

MYRTLE BEACH AFB, SOUTH CAROLINA - MOGAS SITE XXX - INITIAL

Biodegradation Rate Calculations | enter data | calculated data |

Formula: $K_b = K_o \times 1/100\% \times A \times D_o \times C$ Where:

- K_b = fuel biodegradation rate
- K_o = O_2 utilization rate (%/min.)
- A = volume of air/kg soil
- D_o = O_2 density = 1340 mg/L
- C = Carbon/O_2 ratio for hexane mineralization = 1/3.5

Solving for 1 L of soil:

		SV-2		SV-3	SV-5	SV-6
Oxygen util. rate	K_o =	0.02178	%/min.	0.03038	0.00269	0.00659
Moisture Content [a/]	w =	17.7	%	17.7	17.7	17.7
Soil Type [b/]		silty sand		silty sand	silty sand	silty sand
Porosity:	n =	0.35		0.35	0.35	0.35
Unit weight (dry):	$^g d = G * {}^g w * (1-n)$ =	1.72	g/cm^3	1.72	1.72	1.72
Void ratio:	$e = n/1-n$ =	0.54		0.54	0.54	0.54
Specific gravity:	G =	2.65		2.65	2.65	2.65
Void volume:	$V_v = n * 1\ L$ =	0.35	liters	0.35	0.35	0.35
Deg. of saturation:	$S_r = Gw/e$ =	0.87		0.87	0.87	0.87
Volume of water:	$V_w = S_r * V_v$ =	0.3	liters	0.3	0.3	0.3
Volume of air:	$V_a = V_v - V_w$ =	0.05	liters	0.05	0.05	0.05
Bulk density:	$^g d + (V_w * {}^g w)$ =	2	kg/L soil	2	2	2
Air filled volume:	A = V_a/Bulk Density	0.025	L air/kg soil	0.025	0.025	0.025
	K_b =	**1096**	mg TPH/ kg soil/ year	**1528**	**136**	**332**

$K_b = K_o * 1/100\% * A * D_o * C * 525{,}600$ min/yr

[a/] Moisture: Maximum moisture result from laboratory analysis of initial soil samples.

[b/] Assume: Soil properties are specified from Table 1.4. (Ref. Foundation Engineering, Peck, Hanson, and Thornburn, John Wiley Press, 1974)

MYRTLE BEACH AFB, SOUTH CAROLINA - MOGAS SITE XXX - INITIAL

Biodegradation Rate Calculations

enter data	calculated data

Formula: $K_b = K_o \times 1/100\% \times A \times D_o \times C$ Where:

K_b = fuel biodegradation rate
K_o = O_2 utilization rate (%/min.)
A = volume of air/kg soil
D_o = O_2 density = 1340 mg/L
C = Carbon/O_2 ratio for hexane mineralization = 1/3.5

Solving for 1 L of soil:

Monitoring Point:		SV-2		SV-3	SV-5	SV-6
Oxygen util. rate	K_o =	0.02178	%/min.	0.03038	0.00269	0.00659
Moisture Content [a]	w =	15.3	%	15.3	15.3	15.3
Soil Type [b]		silty sand		silty sand	silty sand	silty sand
Porosity:	n =	0.35		0.35	0.35	0.35
Unit weight (dry):	$^g d = G * {}^g w * (1-n)$ =	1.72	g/cm^3	1.72	1.72	1.72
Void ratio:	$e = n/1-n$ =	0.54		0.54	0.54	0.54
Specific gravity:	G =	2.65		2.65	2.65	2.65
Void volume:	$V_v = n * 1\ L$ =	0.35	liters	0.35	0.35	0.35
Deg. of saturation:	$S_r = Gw/e$ =	0.75		0.75	0.75	0.75
Volume of water:	$V_w = S_r * V_v$ =	0.26	liters	0.26	0.26	0.26
Volume of air:	$V_a = V_v - V_w$ =	0.09	liters	0.09	0.09	0.09
Bulk density:	$^g d + (V_w * {}^g w)$ =	2	kg/L soil	2	2	2
Air filled volume:	$A = V_a$/Bulk Density	0.045	L air/kg soil	0.045	0.045	0.045
	K_b =	**1972**	mg TPH/ kg soil/ year	**2751**	**244**	**597**

$K_b = K_o * 1/100\% * A * D_o * C * 525{,}600$ min/yr

[a] Moisture: Average moisture result from laboratory analysis of initial soil samples.

[b] Assume: Soil properties are specified from Table 1.4. (Ref. Foundation Engineering, Peck, Hanson, and Thornburn, John Wiley Press, 1974)

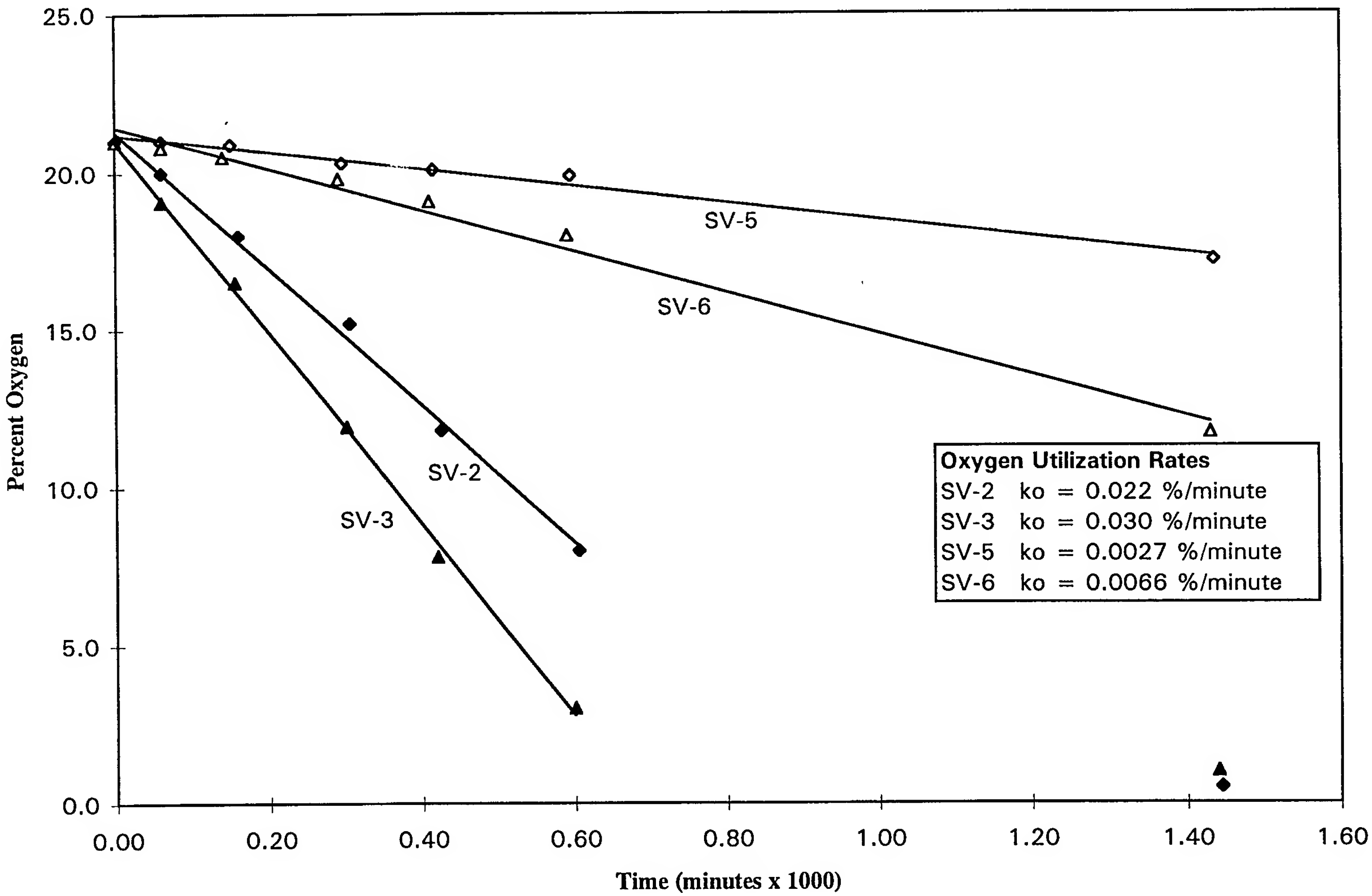
s:\cbs\MYRTDEG2.XLS

Initial Respiration Test
MOGAS Site
Myrtle Beach AFB, South Carolina

Monitoring Point	Date	Days Elapsed (frac. days)	Time	Hrs elapsed (fractional days)	Days Elapsed	Elapsed Time (min. x 1000)	O2%	CO2%	Total Hydro-carbon	Comments	Trend of O2/ Time	New x-values	k
SV-2	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	50		21.3113166	0	0.021780
SV-2	11/15/95	0.00	09:30	0.04	0.04	0.06	20.0	0.0	86		8.02551678	0.61	
SV-2	11/15/95	0.00	11:10	0.11	0.11	0.16	18.0	0.1	160				
SV-2	11/15/95	0.00	13:35	0.21	0.21	0.31	15.2	0.4	200				
SV-2	11/15/95	0.00	15:35	0.30	0.30	0.43	11.8	0.7	230				
SV-2	11/15/95	0.00	18:35	0.42	0.42	0.61	8.0	1.0	280				
SV-2	11/16/95	1.00	08:35	0.00	1.00	1.45	0.5	1.8	400				
SV-3	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	60		20.9880575	0	0.030377
SV-3	11/15/95	0.00	09:30	0.04	0.04	0.06	19.1	0.0	170		2.76199436	0.6	
SV-3	11/15/95	0.00	11:05	0.11	0.11	0.16	16.5	0.1	250				
SV-3	11/15/95	0.00	13:30	0.21	0.21	0.30	11.9	0.5	360				
SV-3	11/15/95	0.00	15:30	0.29	0.29	0.42	7.8	0.7	620				
SV-3	11/15/95	0.00	18:30	0.42	0.42	0.60	3.0	1.1	620				
SV-3	11/16/95	1.00	08:30	0.00	1.00	1.44	1.0	1.8	760				
SV-5	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	44		21.1925474	0	0.002694
SV-5	11/15/95	0.00	09:30	0.04	0.04	0.06	21.0	0.0	200		17.3129278	1.44	
SV-5	11/15/95	0.00	11:00	0.10	0.10	0.15	20.9	0.1	270				
SV-5	11/15/95	0.00	13:25	0.20	0.20	0.30	20.3	0.3	390				
SV-5	11/15/95	0.00	15:25	0.29	0.29	0.42	20.1	0.5	500				
SV-5	11/15/95	0.00	18:25	0.41	0.41	0.60	19.9	0.7	540				
SV-5	11/16/95	1.00	08:25	0.00	1.00	1.44	17.2	0.9	960				
SV-6	11/15/95	0.00	08:30	0.00	0.00	0.00	21.0	0.0	540		21.4501911	0	0.006593
SV-6	11/15/95	0.00	09:30	0.04	0.04	0.06	20.8	0.0	680		12.02231	1.43	
SV-6	11/15/95	0.00	10:50	0.10	0.10	0.14	20.5	0.3	900				
SV-6	11/15/95	0.00	13:20	0.20	0.20	0.29	19.8	0.3	1,500				
SV-6	11/15/95	0.00	15:20	0.28	0.28	0.41	19.1	0.5	2,000				
SV-6	11/15/95	0.00	18:20	0.41	0.41	0.59	18.0	0.7	2,400				
SV-6	11/16/95	1.00	08:20	-0.01	0.99	1.43	11.7	0.9	5,000				

Gray areas - denote data points not included in ko calculation

Initial Respiration Results
MOGAS Site
Myrtle Beach AFB, SC



4/8/96 Notes from
Steve Corchabal
on SVE pilot
test at MOGAS

VR System - Model V2C

☆ VR System Start Date: 10/20/95

Average Extraction Rate: 15 SCFM

Initial Extraction Well: VW-1

Finish VW-1 Date: 11/7/95

(VR) Start VW-2 Date: 11/7/95

(VR) Finish VW-2 Date: 1/30/96

☆ Ultrox Testing Dates:

Short Term Testing : Start Date: 11/10/95
(Various Flow Rates/Concentrations)

Finish Date: 12/20/95

For Results:

Check w/ Doug Downey - I gave him the estimated Total Pounds Removed based on Flow & Concentration Lab data. I would need to go back through all the system printouts to give you this info.

VR Systems – V2C Demo @ Myrtle Bch AFB, S.C.

Vent Well #1

TOTAL Run Time = 20 DAYS
DownTime = 0 DAYS
Flow RATE = Average 15 SCFM

Period	TOTAL Lbs/Removed
10/20 - 10/24 (5 DAYS) @10 SCFM	B = 75 T = 87 E = 13 X = 8 TPH = 1,994
10/25 - 11/7 (14 DAYS) @15 SCFM	B = 255 T = 317 E = 52 X = 23 TPH = 1,939
11/8 (1 DAY) @12 SCFM	B = 1 T = 2 E = <1 X = 1 TPH = 71

TOTAL Lbs Removed @VW1: B = 331, T = 406, E = 65, X = 32, TPH = 4,004

TOTAL lbs Removed (VW1+VW2)
@ VW#1 = 4,004 (TPH)
@ VW#2 = 8,397 (TPH)
12,401

		(% OF TOTAL)
B =	417	3.4
T =	588	4.7
E =	86	0.7
X =	98	0.8
(B,T,E,X) =		9.6 %

TOTAL Run Time VW1+VW2 = 81 days
TOTAL DownTime = 21 days
TOTAL Days OnSite = 102 days

VENT WELL #2

VW#2 - TOTAL Run Time = 61 DAYS
DownTime = 21 DAYS
Flow RATE = Average 15 TO 17 SCFM

Period	TOTAL Lbs/Removed
11/8 - 12/8 (-6 DAYS down) (24 DAYS - Run) @ 15 SCFM	B = 74 T = 139 E = 14 X = 38 TPH = 7,181
12/8 - 12/19 (11 DAYS - Run) @ 17 SCFM	B = 5 T = 17 E = 2 X = 10 TPH = 402
12/20 - 1/24 (20 Run Days) (-15 downtime) @17 SCFM	B = 6 T = 22 E = 4 X = 15 TPH = 640
1/24 - 1/30 (6 days Run) (shutdown on 1/30) @17 SCFM	B = 1 T = 4 E = 1 X = 3 TPH = 174

TOTAL Lbs Removed @VW#2: B = 86, T = 182, E = 21, X = 66, TPH = 8,397

PPMV / uG/L

Vent Well #1

10/20-START

PPMV / uG/L

Average Inf. Concentration For Period

	Flow-SCFM		Influent	% Dest.	Effluent	
10/21/95	10	B=	2,300/7,500	99.9	0.007/ 0.023	B=5,150/ 16,750
		T=	1,800/6,900		0.006/ 0.023	T=5,100/ 19,450
★Average = 10		E=	150/660		0.005/ 0.022	E=675/ 2,980
(For Period 10/20-10/24)		X=	420/1,800		0.017/ 0.075	X=400/ 1,750
5 DAYS-Run		TPH=	180,000/750,000		2.3/ 9.6	TPH=107,500/445,000

				% Dest.		
10/24/95	18	B=	8,000/26,000	99.9	0.86/2.8	B=4,165/13,550
★AVERAGE = 15		T=	8,400/32,000		0.59/2.2	T=4,420/16,850
(FOR Period 10/24-11/7)		E=	1,200/5,300		0.36/1.6	E=629/2,780
14 DAYS-Run		X=	380/1,700	99.9	0.50/2.2	X=280/1,245
		TPH=	35,000/140,000	98.2	640/2,700	TPH=25,500/103,000

				% Dest.		
11/7/95	(7) (High WATER)	B=	330/1,100	99.9	0.06/0.19	★Remains The same
★ AVERAGE = 12		T=	440/1,700		0.009/ 0.034	
(For period 11/7-11/8)		E=	58/260		ND	
1-DAY		X=	180/790		0.003/0.013	
		TPH=	16,000/66,000	99.8	31/130	

Vent Well #2 - Turned off on 1/30/96 (18 scfm)

(11/8-11/10)-ON

(11/11-11/16)-OFF (Respiration Test) -6 days

(12/27-1/10)-OFF (HIGH WATER) - 15 days

	SCFM			% Dest		
12/8/95	19	B=	110/360	99	0.10/ 0.32	B=98/320
★ Average = 17		T=	270/1,000		0.078/ 0.30	T=265/1,000
(For Period 12/8-12/19)		E=	2.0/8.8		0.013/ 0.057	E=23/100
11 DAYS		X=	130/570		0.074/ 0.33	X=135/595
		TPH=	6,000/25,000	99.2	47/200	TPH=5,750/24,000

11/8 TO 12/8 - 6 DAYS = 24 DAYS

STARTUP on VW #2 prior to 12/8 Sampling date.

INITIAL VW #2 DATA =
B= 1,300/4,200
T= 2,000/7,600
E= 200/880
X= 410/1,800
TPH=100,000/420,000

11/8-12/8 24 DAYS
★ 6-DAYS Down

INITIAL STARTUP on VW2 - Average INF. Conc.

B= 720/2,280
T= 1,135/4,300
E= 101/444
X= 270/1,185
TPH = 53,000/222,500

PPMV / uG/L

Vent Well #2

	SCFM	PPMV / uG/L InFluent	% Dest	EFFluent	Average InF. Concentration FOR Period
12/19/95	17				
		B = 85 / 280	99	B = ND	B = 64 / 210
✱ Average = 17		T = 260 / 1,000		T = ND	T = 190 / 730
(FOR period 12/19 - 1/24)		E = 43 / 190		E = ND	E = 33 / 145
35 DAYS		X = 140 / 620		X = ND	X = 110 / 485
(- 15 DAYS) = 20 DAYS RUN		TPH = 5,500 / 23,000	(99)	TPH = 13 / 54	TPH = 5,000 / 21,000

	SCFM		% Dest		
1/24/96	17	B = 43 / 140	99	B = 0.062 / 0.20	B = ✱ Remain
		T = 120 / 460		T = 0.053 / 0.20	T = the same
✱ Average = 17		E = 23 / 100		E = 0.019 / 0.084	E =
For Period 1/24 - 1/30		X = 79 / 350		X = 0.22 / 0.97	X =
SHUTDOWN 6 DAYS		TPH = 4,500 / 19,000	(?)	TPH = 660 / 2,700	TPH =

Could have been cross-Contamin during Sampling

PARSONS ENGINEERING SCIENCE, INC.

Client Myrtle AFB Job No. 725522.03000 Sheet 1 of

Subject Sampling Trip Notes By D. MALONE Date 9-14-95

Checked Rev.

0800 D. Malone arrives on site, met with Mr. Harry FitzGibbon. Drove to Mogas site. Needed 2 - 1/2" PVC Male Adapters. Drove to Lowes.

0900 Opened wells VENT-01, -02, AND SV-01 thru -08

0915 Calibrated MicroTIP HL-2000 (PID) with 100 ppm isobutylene gas. Calibrated O_2/CO_2 meter. CO_2 function not operating.

0930 Take Initial Reading from wells.

	PID	Notes
VENT-01	143 ppm	Strong odor
VENT-02	262	Moderate odor
SV-1	36	
SV-2	976	
SV-3	567	
SV-4	63	
SV-5	73	o Well sealed w/ DUCT TAPE only
SV-6	52	Well sealed w/ DUCT TAPE only o WATER STANDING in Vault over RISER
SV-7	1035	o SAME Notes
SV-8	20	o Well Sealed w/ DUCT TAPE Only

0950 Will Purge AND Sample VENT-01, -02 AND SV-2, SV-7

1000 Set up AT VENT-01

DTW = 9.50' BTOC 4" ø Well

1 well vol = $0.83 ft^3$

3 well vol = $2.5 ft^3$

Pump Q = 32 scfh

purge time = 4.5 minutes.

PARSONS ENGINEERING SCIENCE, INC.

Client ______ Job No. ______ Sheet 2 of ______
Subject ______ By ______ Date ______
Checked ______ Rev. ______

1000 (cont.)

	Initial	5 min	9 min
O_2 =	1%	1%	1%
PID =	96.6 ppm	103	101
THA =	800 ppm	— NR	— NR

Total Hydrocarbon Analyser (THA) reading required ~ 20 minutes to reach background levels. Discontinue taking THA readings.

1023 Set-up at SV-2
$1/2$" ID DTW = 6.48' BTOC
1 Vol = 8.8×10^{-3} ft^3
3 Vol = 0.026 ft^3
purge time ~ 3 sec.

	Initial	2 min	3 min
O_2	11%	10.8%	10.5%
PID	263	261	—

Moderate Odor

1043 Set-up AT VENT-02
4" Ø well ; Assume 3 purge vol => 4.5 min purge time

	Initial	4 min	5 min
O_2	0.5%	0.5%	0.5%
PID	236 ppm	214 ppm	212 ppm

1051 Set-up at SV-7
Assume 3 purge vol = 3 sec

	Initial	30 sec	1 min	1' 30"
O_2	5%	1%	0.5%	0.4%
PID	397 ppm	413 ppm	419 ppm	418 ppm

1100 Sample 4 wells w/ Summa Cannister.

TIME	DATE	LOCATION	Cannister #	
1107	9-14-95	VENT-02	356	94926
1112	↓	SV-7	595	94918
1118		VENT-01	1061	94920
1123		SV-2	696	94929

1500 Spoke w/ Harry FitzGibbon regarding proj status. Tried to call Richard Henry, ES-Denver.

200 Closed up wells. Put PVC caps on wells SV-5 through SV-8 to replace duct tape seal. Put new locks on VENT-01, VENT-02, and MW-06 at Mr FitzGibbons request.

3 Called Fed-X for pickup at the AFB office. (Bldg 212)
Attempted to Reach ES-Denver Again

10 Left site for Raleigh

(12)

CONTENTS

REFERENCE	DATE

10/18/95 725522.03000 SRA

0730 - Onsite AT THE Mogas Site, on Myrtle Bch AFB, S.C. Met w/ HARRY Fitzgibbon BASE P.O.C. To DISCUSS SVE TEST AT THE Mogas Site And obtain Keys FOR Site ACCESS.

0800 - Began TAKing WATER Level Measurements AT AT TOTAL OF 54 points FOR RICHARD Henry OF the PARSONS ES Denver OFFice. Points checked included - MonITORIng Wells, SURFACE WATER - STAFF GAUges, Vent Wells, and Soil GAS Monitoring points.

1800 - Completed Collecting W.L.'s AT All points.

S. [signature]
10/18/95

File 725522.03000

@ AIR TOXICS LTD.

p. He... 24

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 9510285

Work Order Summary

CLIENT: Mr. Steve Archabal
Parsons Engineering Science
1700 Broadway, Suite 900
Denver, CO 80290

BILL TO: Same

PHONE: 303-831-8100
FAX: 303-831-8208
DATE RECEIVED: 10/25/95
DATE COMPLETED: 11/6/95

INVOICE # 8569
P.O. # 725522.03000
PROJECT # 725522.03000 Mogas Site Myrtle Beach, SC
AMOUNT$: $563.54

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	PRICE
01A	VRV1-E1-MB	TO-3	0 "Hg	$120.00
02A	VRV1-I1-MB	TO-3	2.0 "Hg	$120.00
03A	VRV1-E2-MB	TO-3	0.5 "Hg	$120.00
04A	VRV1-I2-MB	TO-3	0.5 "Hg	$120.00
05A	Lab Blank	TO-3	NA	NC
05B	Lab Blank	TO-3	NA	NC

Misc. Charges	1 Liter Summa Canister Preparation (4) @ $10.00 each.	$40.00
	Shipping (10/17/95)	$43.54

OK DD

CERTIFIED BY: Linda L. Freeman
Laboratory Director

DATE: 11/7/95

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA 95630
(916) 985-1000 • (800) 985-5955 • FAX (916) 985-1020

AIR TOXICS LTD.

SAMPLE NAME: VRV1-I1-MB

ID#: 9510285-02A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6102710		Date of Collection: 10/21/95	
Dil. Factor:	5400		Date of Analysis: 10/27/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	5.4	18	2300	7500
Toluene	5.4	21	1800	6900
Ethyl Benzene	5.4	24	150	660
Total Xylenes	5.4	24	420	1800

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6102710		Date of Collection: 10/21/95	
Dil. Factor:	5400		Date of Analysis: 10/27/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	54	220	180000	750000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: VRV1-E2-MB

ID#: 9510285-03A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6110105		**Date of Collection:** 10/24/95	
Dil. Factor:	6.4		**Date of Analysis:** 10/31/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	0.006	0.019	0.86	2.8
Toluene	0.006	0.023	0.59	2.2
Ethyl Benzene	0.006	0.026	0.36	1.6
Total Xylenes	0.006	0.026	0.50 M	2.2 M

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6110105		**Date of Collection:** 10/24/95	
Dil. Factor:	6.4		**Date of Analysis:** 10/31/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2-C4 Hydrocarbons)	0.064	0.27	1900	7900
TPH* (C5+ Hydrocarbons)	0.064	0.27	640	2700

*TPH referenced to Gasoline (MW=100)

M = Reported value may be biased due to apparent matrix interferences.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: VRV1-I2-MB

ID#: 9510285-04A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6110107		Date of Collection: 10/24/95	
Dil. Factor:	5100		Date of Analysis: 10/31/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	5.1	17	8000	26000
Toluene	5.1	20	8400	32000
Ethyl Benzene	5.1	23	1200	5300
Total Xylenes	5.1	23	380	1700

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6110107		Date of Collection: 10/24/95	
Dil. Factor:	5100		Date of Analysis: 10/31/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	51	210	35000	140000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank
ID#: 9510285-05A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6102703		Date of Collection: NA	
Dil. Factor:	1.0		Date of Analysis: 10/27/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name:	6102703		Date of Collection: NA	
Dil. Factor:	1.0		Date of Analysis: 10/27/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	0.010	0.042	Not Detected	Not Detected

*TPH referenced to Gasoline (MW=100)

Container Type: NA

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 9510285-05B

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6110104		Date of Collection: NA	
Dil. Factor:	1.0		Date of Analysis: 10/31/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6110104		Date of Collection: NA	
Dil. Factor:	1.0		Date of Analysis: 10/31/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	0.010	0.042	Not Detected	Not Detected

*TPH referenced to Gasoline (MW=100)

Container Type: NA

AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

CHAIN-OF-CUSTODY RECORD

Nº 008264

Contact Person STEVE ARCHABAL
Company PARSONS Engineering SCIENCE INC
Address 1700 BROADWAY SUITE 900 City DENVER State CO Zip 80290
Phone (303) 831-8100 FAX (303) 831-8208
Collected By: Signature Steven R. Archabal

Project info:
P.O. # 725522.03000
Project # 725522.03000
Project Name MOGAS SITE MYRTLE BEACH, SC

Turn Around Time:
☒ Normal
☐ Rush ______ Specify

Lab I.D.	Field Sample I.D.	Date & Time	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
01A	VRV1-E1-MB	10/21/95; 1200	TO-3 (BTEX) + TPH	28.5"Hg	0.0"Hg	0"Hg
02A	VRV1-I1-MB	10/21/95; 1215	TO-3 " "	28.5"Hg	1.5 TO 1.8"Hg	2.0"Hg
03A	VRV1-E2-MB	10/24/95; 0845	TO-3 " "	29.4"Hg	0.0"Hg	0.5"Hg
04A	VRV1-I2-MB	10/24/95; 0900	TO-3 " "	28.5"Hg	2.0"Hg	0.5"Hg 10/25/95

Relinquished By: (Signature) Date/Time Steven R. Archabal 10/24/95 Print Name STEVEN R. ARCHABAL
Relinquished By: (Signature) Date/Time Steven R. Archabal 10/24/95 Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time Received By: (Signature) Date/Time [illegible] ATL 10/25/95 10:10

Notes:
REFERENCE TO GASOLINE (MW=100)

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Date/Time	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	FEDEX	4616485414	[illegible]	10/25/95 10:10	Ambient	Good	Yes No None N/A	9510285

WORK ORDER #: 9511098A

Work Order Summary

CLIENT: Mr. Steve Archabal
Parsons Engineering Science
1700 Broadway, Suite 900
Denver, CO 80290

BILL TO: Same

PHONE: 303-831-8100
FAX: 303-831-8208
DATE RECEIVED: 11/9/95
DATE COMPLETED:

INVOICE #
P.O. # 726876.66132
PROJECT # 726876.66132 MOGAS SITE
AMOUNT$: $260.00

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	PRICE
01A	VRV1-E3-MB	TO-3	1.0 "Hg	$120.00
02A	VRV1-I3-MB	TO-3	2.0 "Hg	$120.00
03A	Lab Blank	TO-3	NA	NC

Misc. Charges 1 Liter Summa Canister Preparation (2) @ $10.00 each. $20.00

PRELIMINARY

CERTIFIED BY: Debbie Pearce for
Laboratory Director

DATE: 11-14-95

AIR TOXICS LTD.

SAMPLE NAME: VRV1-E3-MB

ID#: 9511098A-01A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6111307 Date of Collection: 11/7/95

Dil. Factor: 2.1 Date of Analysis: 11/13/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	0.060 M	0.19 M
Toluene	0.002	0.008	0.009	0.034
Ethyl Benzene	0.002	0.009	Not Detected	Not Detected
Total Xylenes	0.002	0.009	0.003	0.013

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name: 6111306 Date of Collection: 11/7/95

Dil. Factor: 10 Date of Analysis: 11/13/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C2+ Hydrocarbons)	0.10	0.42	31	130

*TPH referenced to Gasoline (MW=100)

M = Reported value may be biased due to apparent matrix interferences.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: VRV1-I3-MB
ID#: 9511098A-02A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6111309 Date of Collection: 11/7/95
Dil. Factor: 5400 Date of Analysis: 11/13/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	5.4	16	330	1100
Toluene	5.4	21	440	1700
Ethyl Benzene	5.4	24	58	260
Total Xylenes	5.4	24	180	790

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name: 6111309 Date of Collection: 11/7/95
Dil. Factor: 5400 Date of Analysis: 11/13/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C2+ Hydrocarbons)	54	220	16000	66000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 9511098A-03A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6111304	Date of Collection: NA
Dil. Factor:	1.0	Date of Analysis: 11/13/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6111304	Date of Collection: NA
Dil. Factor:	1.0	Date of Analysis: 11/13/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C2+ Hydrocarbons)	0.010	0.042	Not Detected	Not Detected

*TPH referenced to Gasoline (MW=100)

Container Type: NA

File 725522.03

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 9509145

Work Order Summary

CLIENT:	Mr. Richard Henry Parsons Engineering Science 1700 Broadway, Suite 900 Denver, CO 80290	**BILL TO:**	Ms. DeAnna Schenfeld Parsons Engineering Science 1700 Broadway, Suite 900 Denver, CO 80290
PHONE:	303-831-8100	**INVOICE #**	8023
FAX:	303-831-8208	**P.O. #**	725522.3000
DATE RECEIVED:	9/15/95	**PROJECT #**	725522.3000 Myrtle Beach AFB
DATE COMPLETED:	9/22/95	**AMOUNT$:**	$559.49

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	PRICE
01A	VENT-02	TO-3	1.0 "Hg	$120.00
02A	SV-7	TO-3	1.0 "Hg	$120.00
03A	VENT-01	TO-3	1.0 "Hg	$120.00
04A	SV-2	TO-3	0.5 "Hg	$120.00
05A	Lab Blank	TO-3	NA	NC

Misc. Charges	1 Liter Summa Canister Preparation (4) @ $10.00 each.	$40.00
	Shipping (9/11/95)	$39.49

CERTIFIED BY: Linda L. Freeman
Laboratory Director

DATE: 9/22/95

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA 95630
(916) 985-1000 • (800) 985-5955 • FAX (916) 985-1020

AIR TOXICS LTD.

SAMPLE NAME: VENT-02

ID#: 9509145-01A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6092014		Date of Collection: 9/14/95	
Dil. Factor:	17000		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	17	55	1300	4200
Toluene	17	65	2000	7600
Ethyl Benzene	17	75	200	880
Total Xylenes	17	75	410	1800

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6092014		Date of Collection: 9/14/95	
Dil. Factor:	17000		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	170	710	100000	420000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SV-7

ID#: 9509145-02A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6092025		Date of Collection: 9/14/95	
Dil. Factor:	10000		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	10	32	800	2600
Toluene	10	38	1000	3800
Ethyl Benzene	10	44	150	660
Total Xylenes	10	44	280	1200

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6092025		Date of Collection: 9/14/95	
Dil. Factor:	10000		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	100	420	64000	270000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: VENT-01
ID#: 9509145-03A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6092024		Date of Collection: 9/14/95	
Dil. Factor:	10000		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	10	32	1300	4200
Toluene	10	38	910	3500
Ethyl Benzene	10	44	62	270
Total Xylenes	10	44	120	530

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name:	6092024		Date of Collection: 9/14/95	
Dil. Factor:	10000		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	100	420	180000	750000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SV-2

ID#: 9509145-04A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6092022		Date of Collection: 9/14/95	
Dil. Factor:	5100		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	5.1	17	310	1000
Toluene	5.1	20	200	760
Ethyl Benzene	5.1	23	8.7	38
Total Xylenes	5.1	23	15	66

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6092022		Date of Collection: 9/14/95	
Dil. Factor:	5100		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	51	210	28000	120000

*TPH referenced to Gasoline (MW=100)

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank
ID#: 9509145-05A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6092006		Date of Collection: NA	
Dil. Factor:	1.0		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name:	6092006		Date of Collection: NA	
Dil. Factor:	1.0		Date of Analysis: 9/20/95	
Compound	**Det. Limit (ppmv)**	**Det. Limit (uG/L)**	**Amount (ppmv)**	**Amount (uG/L)**
TPH* (C2+ Hydrocarbons)	0.010	0.042	Not Detected	Not Detected

*TPH referenced to Gasoline (MW=100)

Container Type: NA

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

CHAIN-OF-CUSTODY RECORD

No 005216

Page ___ of ___

Contact Person: Richard Henry
Company: PARSONS Engineering Science INC
Address: 1700 Broadway Suite 900 City: Denver State: CO Zip: 80290
Phone: 303-831-8100 FAX: 303-831-8208
Collected By: Signature: Donald Malone

Project info:
P.O. #: 725522.03000
Project #: ✓
Project Name: Myrtle Beach AFB

Turn Around Time:
☐ Normal
☒ ~~Rush~~ Specify: Richard
See Henry

Lab I.D.	Field Sample I.D.	Date & Time	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
01A	VENT-02	9-14-95 1107	BTEX, TVH (EPA→T-03			1.0"Hg
02A	SV-7	9-14-95 1112	BTEX, TVH T-03			1.0"Hg
03A	VENT-01	9-14-95 1118	BTEX, TVH T-03			1.0"Hg
04A	SV-2	9-14-95 1123	BTEX, TVH T-03			0.5"Hg

Relinquished By: (Signature) Date/Time: Donald Malone 9-14-95/1258 Print Name: DONALD MALONE
Relinquished By: (Signature) Date/Time — Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time — Received By: (Signature) Date/Time: [signature] 0945 9/15/95

Notes: Sent Via Fed-X

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Date/Time	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	FEDEX.	7376617 942	TRS.	9/15/95-0945	AMBIENT	Good	Yes No None N/A	9509145

Form 1293 rev. 06

10/19/95 725522.03000 SRA

0730- Onsite @ Mogas Site. Need to install Soil gas Monitoring points Sampling Valves and Fittings @ All SV points (#1-8). It is necessary to remove the concrete grout within the manhole Area @ 6 of the 8 points in order to have enough room to install the valves

1800 - Completed repairing All SV points. Left Site

10/19/95

10/20/95 725522.03000 SRA

0730- Onsite @ Mogas Site. Need to collect initial Soil Gas Readings at All the SV and VW locations, Prior to Starting up the VR Systems SVE Unit.

1400 - Completed obtaining All Soil gas Measurements.

Monitor Point	O_2 (%) GASTECH	CO_2 (%) GASTECH	TVH - Horiba Inst. (PPMV)	Comments
VW-1	0.0	>25.0	>37,000	?
VW-2	2.0	>25.0	>34,000	?
SV-1	0.0	23.0	30,000	?
SV-2	0.5-Initial 5.5-Rebound	22.0 10.0	25,000	? Possible Short-Circuit.
SV-3	0.0	>25.0	>34,000	?
SV-4	2.0-Initial 15.0-Rebound	21.0 5.0	1,000	High Vacuum Leaking Well
SV-5	0.0	>25.0	>33,000	?
SV-6	0.0	>25.0	>35,000	?
SV-7	0.0	>25.0	>32,000	?
SV-8	0.0	23.0	6,000	

? = Reading beyond Horiba Linear range of 10,000 ppmv.

10/20/95 725522.03000 SRA

1500 - STARTED Hooking-up SVE System - Including Knock-Drum, Hoses, etc. Needed to buy Fittings, Hoses.

1800 - Completed Hooking up System (VR unit, Drum, Hoses, etc), STARTED up VR System @ Low Flow due to the very High CO_2 content in the soil gas. Will Leave unit at 6 to 8 CFM, ≈ 35" to 40" H_2O vacuum, pulling from VW-1 location. Inital Flow Rate was able to shut off Supplemental Fuel usage.

S. [signature]
10/20/95

10/21/95 725522.03000 SRA

0800 - Onsite @ Mogas Site. Need to regrout the Inside Area of the SV manholes.

1100 - Collected VR System Influent & Effluent Readings w/ Horiba.

Inst. Background	INF	EFF	Parameter
0-4	33,500?	1 to 2	HC ppmv
0.0	13.80	15.60	CO_2 %
0.0	0.08	0.10	CO %

1200 - Collected Summa Cannister Samples From Inf/Eff of System.

EFF: Canister # 12364
Initial Canister VAC = 28.5 "Hg
Final " " = 0.0 "Hg
Sample Time = 10/21/95, 1200
Sample ID. = VRV1-E1-MB

10/21/95 725522.03000 SRA

1200 - (CONT.)

INF.: CANISTER # 11433

SAMPLE I.D. = VRV1-I1-MB

SAMPLE TIME = 1215

INITIAL VAC. = 28.5" Hg

Final VAC. = 1.5-1.8" Hg

★VR UNIT PARAMETERS:

RPM = 2300	Carb. Position = 19%
EXHAUST = 1089°F	Well Flow = 10 CFM
Duty Cycle = 48-50	Well Valve = 6%
Eng. Hrs = 1181	VAC "H_2O = 40"-42"
Fuel Flow = 0.0 CFM	Fuel TOTAL = 9161

1600 - LEFT SITE, TO FED EX.

S. Archibald
10/21/95

10/22/95 725522.03000 SRA

0800 - ONSITE @ MOGAS SITE. Checked VR unit, Noticed Supplemental Fuel Consumption had increased From 0.0 To 0.5 @ 2,300 RPM. So I decreased RPM To 2,000 And Supplemental Fuel Consumption dropped to 0.3 CFM.

Eng. Parameters @ 2,000 RPM

	0845 -	1420 -
RPM =	2,000	2,000
Duty Cycle =	50	50
CARB % =	18	18
Well Flow =	13	15
Well VAC =	40	41
Fuel Flow =	0.3	0.3
Fuel TOTAL =	9570	9693
Eng Hrs =	1201	1207
Well Valve % =	7	8

1700 - Stopped by to check System. Opened Well Flow to 18 CFM and Lowered RPM To 1900 To Conserve Supp. Fuel.

S. Archibald 10/22/95

10/23/95 725522.03000 SRA

0745- OnSITE @ Mogas SITE
System Running.

0800- Checked Pressure Readings
@ SV-1, SV-2 & SV-3 in
The Vicinity of VW-1.

SV#	VAC "H_2O	O_2	CO_2
1 (43-FT From VW)	0.60	17.8	5.5
→ This Point in Former Tank Pit Area			
2 (15-FT From VW)	5.2	5.5	14.2
3 (35-FT From VW)	4.0	0.0	25.0

→ These Points Are in Native Soil.

1600- Left Site.

S. Archntal
10/23/95

10/24/95 725522.03000 SRA

0730- OnSITE @ Mogas SITE.
Setup HORIBA to Take
Readings From VR Unit.

0830-
HORIBA Readings:

	HC	CO_2	CO
Background =	0-2	0.04	0.01
INF. =	23,800?	15.20	
? = beyond Inst. Linear Range of 10K.			
EFF. =	19-27*	15.30	0.03

* Due to Very High INF. CO_2
(15.20) - Eng. was running rough
and high EFF. Reading due
to incomplete combustion.

0845- Collected Samples From
INF + EFF. (Summa Canister)
EFF. = Sample time = 0845
Canister # 14507, Initial VAC = 29.4" Hg
Final VAC = 0.0" Hg
INF = Sample Time = 0900
Initial VAC. = 28.5, Final VAC = 2.0" Hg
Canister # 11823

0915 - VR UNIT PARAmeters:
RPM = 2000 Well VAlve% = 9
EXH °F = 1200 Well VAc = 40" H_2O
DUTY = 46 Fuel Flow = 0.5-0.6 CFM
Eng Hrs = 1249 Fuel TOTAL = 10898 CF
CARB% = 19
Well Flow (CFM) = 18

1030 - Completed Replacing Fuel Valve & Gear Motor Assembly, LORAN w/VR SYS. Arrived onSITE WITH Replacement parts to perform work.

1100 - VR UNIT back in operation AT VW1 LOCATION.

1700 - FINISHED Going to FED EX TO SHIP SAmples. LEFT SITE.

S. Archuleta
10/24/95

0730 - On SITE @ Mogas SITE. Met w/ HARRY FITZGIBBON @ BASE OFFICE to DISCUSS The ULTROX Demo, VR SYSTEM, and MEETING FOR 11/9/95 WITH William Pence and Company @ Their office.

0900 - Zimpro/ULTROX Personnel ARE ONSITE @ MOGAS SITE setting up Demo System.

1200 - Collected SOIL GAS Readings @ SV-1,2,3 And InFluent to VR SYSTEM.

SOIL GAS Point	HC (PPMV)	CO_2 %	O_2 %	CO % (VR EFF only)
SV-1	20	1.95	18.3	
SV-2	>13,000?*	16.20	1.0	
SV-3	9,500	17.11	0.9	
VR INF	12,300?	10.75	6.3	
VR EFF	20-60 (FLUCTUATING)	13.50	1-2	

*? = Reading beyond Linear RAnge (10K)

11/7/95 726876.66132 SRA

1330 - Sampled INF. + EFF
From VR unit Prior to
Moving From Vent Well #1
To Vent Well #2.

Sampling Times:

1330 - EFF - Caniter # 20779
("Hg) Int. VAC. = 27.5 / Final 0.0

1345 - INF - Canister # 14523
("Hg) Int. VAC = 27.5 / Final 0.0

Engine Parameters @ Sampling:

Well Flow = 7 scfm	Duty = 50%
Well VAC = 16" H_2O	Fuel Total = 24,395
Well Valve = 3%	Fuel Flow = 0.7 cfm
Exhaust = 900°F	Carb = 14%
RPM = 1550	Eng Hrs = 1589

1500 - Remove VR unit From V1 and
Moved to V2 Location.
1630 - Finished Setting up VR unit
on V2 and Started up System
Steve Archabal 11/7/95

11/8/95 726876.66132 SRA
★ ~~1000~~ - 1200 - MTG. W. BASE (See Following Page)
SRA ~~1300~~ - On site @ Mogas Site.
1300 Ultrox Personnel Continue
Setting up System. Will
Collect Initial CAL. Samples
@ Two Different Concentrations.

1500 - Began Initial Calibration
Sample Collection. Also, Collected
Ambient Air Monitoring Readings.
Samples Collected @ Two
Concentrations:

Time	
1530 - Ultrox - CAL 1	1630 - Ultrox - CAL 2
Canister # 11335	# 21025
Int. VAC. = 28.0 " Hg	28.0 " Hg
Final VAC = 0.0 " Hg	0.0 " Hg
Gastech = 880-900 ppmv	3,000 ppmV
Horiba = 420 ppmV	1550 ppmV
(Lab = 600 ppmv) ★	(2,500 ppmV) ★

★ Lab Results From Air
Toxics Reported on
11/9/95.
Steve Archabal
11/8/95

11/8/95 726876.66132 SRA

0800-1230 - Meeting w/BASE Pesonnel (Harry Fitzgibbon, Dick Souza) Also William Pence (Attorney), S.C. STATE And OTHER Consultant (ECT) TO DISCUSS STATUS OF POL INVESTIGATION @ Myrtle Bch AFB AS well AS STATUS OF Adjacent Property which AIR Force leased to Private company during ACTIVE STATUS - Fueling operations.

S. [signature]
11/8/95

11/9/95 726876.66132 SRA

0730 - ONSITE @ MOGAS SITE, Met w/ULTROX Personnel TO GO OVER ENTIRE SYSTEM Piping + Flow Process.

1000 - 1700: Following review OF the SYSTEM Schematic, THE SYSTEM in the Field @ the MOGAS SITE WAS Labeled at every possible Sample Point including:

- BTEX Sample Points
- AIR Flow Sample Points
- Temperatures
- Ozone Concentrations
- Pressures / VACUUMS

Will START SHORT TERM Testing on 11/10/95, Following results OF AIR TOXICS DATA on CAL. Samples (1+2).

S. [signature]
11/9/95

11/10/95 726876.66132 SRA

0745 - ONSITE AT GATE, WAITING on ULTROX Personnel to Arrive.

0800 - ULTROX Personnel Arrive onSITE.

0820 - Began WARMING UP GASTECH Meter (HC) FOR CALIBRATION.

☆ NOTE: Conversion FACTORS FOR INSTRUMENTS will be:

(PPMV) GASTECH Reading	(PPMV) LAB Result	SRA ~~MULTIPLY~~ DIVIDE BY (GASTECH) Reading by to get A Closer ACTUAL
880-900	600	1.5
3000	2,500	1.2

*SO, FOR Readings below 1,000 ppmv on GASTECH use 1.5 FACTOR; And FOR TESTING ABOVE 1,000 ppmv use 1.2 FACTOR.

0845 - Reset D-Tox system Influent To 290 ppmv on the GASTECH

11/10/95 726876.66132

0845 - (CONT.) in order to get close To Initial Test Parameter of 200 ppmv-LAB.

0900 - CHECK SUMMA CANISTER Pressures/VACUUMS: (Following Sampling)
94927 = 27.0"Hg Initial / 0.0"Hg Final
9536 = 27.5"Hg Initial / 0.0"Hg Final

0915 - Allowing ULTROX SYSTEM STABILIZE @ Initial Concentration.

1000 - Collected Ambient Readings

1050 - 1100 - Collected System Readings AT VARIOUS Sampling Points.

☆ Summa Canister Sample Times:
1115 - ULTROX - 15200 - I
1120 - ULTROX - 15200 - E

1200 - Following CHECKS AT THE INTERMEDIATE Sample Points - IT WAS Found that there was An Increase in Hydrocarbon Concentrations AFTER THE Second (2nd) D-Tox BED And BEFORE the Ozone decomposer. THE Breakdown

11/10/95 726876.66132 SRA

1200 (CONT.) OF HydrocARBon Readings using the GASTECH Meter WAS:

1) Actual InFluent = 280-300 ppmv (AFTer Dilution)
2) AFTER 1ST D-Tox Bed = 170 ppmv
3) AFTER 2nd D-Tox Bed = 1,400 ppmv
4) AFTER O_3 Decomposer = 84 ppmv

1230 - Increased InFluent to next Test Condition of ≈ 800 ppmv (LAB), So the GASTech Reading WAS Around 1,100 using a (1.3 to 1.4 Conversion FACTOR).

☆ NOTE: Will Allow the System to Stabilize at this Condition Then check destruction EFFICIENCIES at the VARIOUS Sampling Points.

1300 - Ozone generator blew A Fuse - Zimpro personnel tried to Fix, but need to replace A Fitting on the generator.

11/10/95 726876.66132 SRA

1300 - (Cont.) I was told that A Fitting in the cooling water piping was Leaking - causing An electrical short and System Shutdown. Also, It is Anticipated that At least 2-Hours will be necessary to Fix the problem.

1600 - Zimpro Personnel STATED That They were STILL Troubleshooting System And were contacting the MANUFACTURER Regarding the Problem. LEFT SITE

2130 - Curt Cooley w/Zimpro called me AT THE Hotel And Advised me that they got the ozone generator Running Around 2000 (8pm). Also they shut off the well gas for the evening; but LEFT the ozone Generator operating to see IF Any problems reoccur.

S. Archabal 11/10/95

11/11/95 726876.66132 SRA

0730 - Onsite at the gate of Mogas site, waiting for Zimpro personnel.

0800 - Shut down VR unit.

0900 - Started up next test condition @ 15 CFM & 800 ppmv (LAB), although Gastech reading was 1,050 ppmv to compensate for the correction factor.

1030 - Continue to allow system to stabilize. Zimpro personnel installing a tarp cover over the opening of the truck wash bays extending down approx. 7-FT from top of opening - leaving a 5' to 6'-FT entrance space between the ground and bottom of the tarp.

1100 - Collected test condition parameters from system and ~~log~~ SRA onto data collection sheet.

11/11/95 726876.66132 SRA

Also, collected ambient readings

1140 - Collected INF + EFF samples

Sample times: (Test condition 15 scfm @ 800 ppmv-Lab)

1140 - EFF - Canister # 9432

1145 - INF - Canister # 9459

1200 - Checked ozone concentration on system EFF and between Bed #2 & O_3 decomposer.

* EFF from Bed #2 = 50-100 ppm

* EFF from entire system = < 0.05 ppm

It appears that the O_3 decomposer is working well.

* Reading were taken using Drager tubes @ 2-different concentrations.

1230 - Replacing rotometer on influent in order to reach next test condition of 1,500 ppmv.

1300 - System shutdown due to high bed temp in Bed #1 over 300° F.

11/11/95 726876.66132

1400 - Set up INFLUENT on NEXT TEST CONDITION @ 1,500 ppmV, * ALTHOUGH I'M USING ≈ 1,800 ppmV on the GASTECH INST.

1600 - Collected SYSTEM Readings And RECORDED OF DATA Collection SHEETS. Also collected Ambient Readings.

1630 - Collected INF + EFF SAmples FOR TEST CONDITION ULTROX - 15/1500 OR 1,500 ppmV INF. @ 15 CFM.

SAmple Times:

EFF = 1630, CANISTER #94912

INF = 1645, CANISTER #9527

1700 - NEXT TEST SETTING will be 15 SCFM @ 3,000 ppmV (LAB) GASTECH READING = 3,600 ppmV USING the 1.2 correction FACTOR

1730 - Completed Setting up SYSTEM FOR NEXT CONDITION: GASTECH = 3,600, (INITIAL) O_2 = 18.1, CO_2 = 2.1.

11/11/95 726876.66132 SRA

1740 - Will Leave System at NEXT CONDITION OVERNIGHT TO STABILIZE.

1750 - LEFT SITE.

S. [signature]

11/11/95

11/12/95 726876.66132 SRA

0800 – Onsite AT Mogas Site.

0830-0900 – Collected Readings From System prior to sampling. Recorded Parameters on Field DATA Collection sheet

0900 – Collected Ambient Readings Summa Canister Samples Taken For System Test Conditions ULTROX – 153000 or 3,000ppmv (LAB) GASTech Reading @ Sampling WAS 3,600 (due to correction FACTOR).

Sample Time: Canister #
EFF = 0930 #9528
InF = 0940 #9431

1000 – SET System up on next Test Condition of 5,000 ppmv (LAB)
☆ GASTech Reading of 6,000 ppmv WAS used due to the 1.2 correction FACTOR. Will Let System Stabilize.

11/12/95 726876.66132 SRA

1115 – Collected System Readings Prior to Sampling. Readings were recorded on DATA Collection Field Sheets.

1120 – Collected Ambient Readings.

1145 – Collected Summa Canister Samples FOR Test Condition of 15 scfm @ 5,000 ppmv (LAB)
Actual Sample Times:
InF = 1145 Canister # 9398
EFF = 1150 Canister # 9369

☆ NOTE: InF. Concentration Fell From ≈ 6,000 To ≈ 5,500 ppmv @ Sample time over the 1½ Hrs STABILIZATION period.

1220 – Zimpro (Curt Cooley) began Setting System up on next Test Condition. Since destruction Efficiencies Are not AT expected levels As were Stated in The Work Plan (Zimpro), It is recommended that A reduction in Flow RATE From 50 cfm To

11/12/95 726876.66132 SRA

1220 - (Cont) 30 CFM be considered before collecting samples. Will need to contact Marty Faile @ AFCEE and Doug Downey (Parsons ES) to approve this change from the work plan.

1400 - Checked system inf. @ new condition of 30 CFM @ 200 ppmv (LAB) or ≈300 ppmv on GASTECH Inst.

1430 - LEFT SITE.

S. [signature]
11/12/95

11/13/95 726876.66132 SRA

0730 - Stopped by Mogas site. VR system still operating, Zimpro personnel NOT @ site.

0745 - At Fed Ex office to ship Ultrox Eval-Air samples (Test conditions: 200, 800, 1500, and 3,000, and 5,000 ppmv @ 15 SCFM.) Waiting for Fed Ex to open @ 0800.

0830 - Zimpro arrived onsite.
0840 - Collected some pressure and soil gas readings from VR unit and SV-6, 7 & 8.

VR UNIT: VAC = 37"; Well Flow = 15 CFM

SV #	O_2	CO_2	HC	VAC "H_2O
6	0.0	11.8	>20K	7.0
7	16.3	3.3	1,400	6.0
8	20.3	1.0	150	1.8

11/13/95 126816, 06132 SRA

0915 - Checked System (OLTROX) INF., IT HAD DROPPED FROM 300 ppmv TO 200 ppmv GASTECH Reading, So, I INCREASED the INF. back up to 300 ppmv @ Flow OF 30 CFM.

1100 - Spoke w/MARTY FAILE @ AFCEE TO get Concurrance that The Flow RATE AT THE NEXT Set OF Test Conditions Should be 30 SCFM INSTEAD OF 50. MARTY Agreed that would be Fine.

1145 - Collected System Parameters FOR Test Conditions at 30 CFM @ 200 ppmv (LAB) GASTECH Reading HAD Rebounded To 440 ppmv From 300 ppmv Set earlier.

1150 - Colleted Ambient Readings.

1210 - Collected INF + EFF Samples

Sample Times: EFF = 1210 #9492
INF = 1215 #9356

11/13/9[illegible] [illegible]87 66132 SRA

1230 - Set-up System @ Next Test Condition OF 30 CFM @ 800 ppmv (LAB) - GASTECH Reading ≈ 1,050 - 1,100 ppmv

1415 - Colleted System Readings Prior to Sampling; DATA Collected on Field Sheets. Also Collected Ambient Readings.

1430 - Collected Summa Canister Samples FOR Condition OF 30 CFM @ 800 ppmv (LAB); GASTECH Readings HAD Rebounded To 1,300 ppmv @ Sample time.

Sample Times:
EFF = 1430 - Canister #94924
INF = 1440 - " #94920

1445 - Set System up on next Test Condition OF 30 CFM @ 1,500 ppmv (LAB); GASTECH Set Limit is 2,000 ppmv.

1700 - Collected System Readings Prior to Sampling @ 30 SCFM @ 1,500 ppmv (LAB); GASTECH Reading was 2,000 ppmv.

* Also Collected Ambient Readings.

1700 - Samples Collected:
Sample Times:

INF = 1700 - Canister # 9487
EFF = 1710 - " # 9399

1730 - Setup System on Next Condition - 30 CFM @ 3,000 ppmv. GASTECH Reading was set @ 3,600 ppmv. Will Allow System to operate overnight And Sample in the morning.

1840 - Left Site

S. [signature]
11/13/95

0730 - Onsite @ Mogas Site. Zimpro personnel onsite.

0755 - Collected System Readings Prior to sampling at Condition of 30 CFM, 3,000 ppmv (LAB); GASTECH Readings = 3,200 @ Sample time. Also Collected ~~System~~ ERA Ambient Readings.

0800 - Collected INF + EFF Samples, Sample Times:
EFF = 0800 - Canister # 9428
INF = 0810 - " # 9434

0830 - Zimpro / Curt Cooley needs to change out Rotometer on INF. Line to obtain Next Test Condition at 30 CFM @ 5,000 ppmv (LAB), GASTECH Reading should be set around 6000 ppmv.

0930 - Set System up on next Test of 30 CFM @ 5,000 ppmv (LAB)

11/14/95 726876.66132 SRA

0930-(Cont.) GASTECH Reading set AT 6,000 ppmv. Will Allow System to STABILIZE before Sampling.

1110 - Collected System Readings Prior to Sample Collection AT TEST Condition OF 30 SCFM (26.8 ACTUAL), 5,000 ppmv (LAB) - GASTECH Reading WAS 5,500 INF. Also Collected Ambient Readings.

1120 - Collected Summa Canister Samples INF + EFF. Sample Times:
EFF = 1120 Canister #93107
INF = 1130 " " 9510

1500 - Zimpro Completed Securing System, until They return to STARTUP the Long-Term Testing.

1630 - LEFT SITE

S. Archabal
11/14/95

11/15/95 726876.66132 SRA

0800 - Onsite @ MOGAS SITE. VR System HAS Been OFF FOR 4 DAYS (Since 11/11/95 @ 0800).

0830 - 1100 - TRIED TO RESTART VR in cold weather - Ambient Temp 36-40°F w/ wind chill High 20's. VR would not START, HAD TO GO TO AUTO PARTS STORE TO GET STARTING FLUID. Took Several Attempts to get STARTED - BATTERY DRAINED During Attempts and HAD TO Borrow Jumper Cables FROM BASE personnel.

1130 - Finally got VR Unit STARTED.

1200 - Collected Some INITIAL Soil GAS Readings FROM SV's 2,3,5,6,7 PRIOR TO Conducting AIR INJECTION/RESPIRATION TESTING. Reading were recorded on Field DATA Collection Sheets.

11/15/95 726876.66132 SRA

1230 - Continue to let VR unit Run to Re-charge BATTERY.

1600 - Don Malone / Parsons ES - CARY, N.C. OFFICE Arrived onsite, Set up AIR Injection Test AT SV-2, 3, 5 And 6. Will Conduct Respiration Test on 11/16/95.

1700 - LEFT SITE

S. [signature]
11/15/95

11/16/95 726876.66132 SRA

0800 - Onsite @ Mogas Site

0830 - SHUT OFF AIR Injection Test And Began Respiration Testing. AIR Injection was APPROX. 16 HOURS. Initial Respiration Testing Readings were collected AT 0830 And Recorded on Field DATA Collection Sheets.

0930 - Collected Respiration Readings. GAVE Don Malone A walk Through of the ULTROX System And sampling program FOR During the 30-DAY EVALUATION.

1110 - Collected Respiration Readings. Gave Don Malone A walk Through of the VR System, so He can check on system during the ULTROX EVAL.

1335 - Collected Respiration Readings.

11/16/95 726876.66132 SRA

1535 - Collected Respiration Readings.
1835 - Collected Respiration Readings.
1900 - Left Site

S. Archabal
11/16/95

11/17/95 726876.66132 SRA

0800 - Onsite @ Mogas Site
0830 - Collected Last Round of Respiration Readings.
0900 - Replaced one of the Remote Starting on/off switches on the Door on the Coolant/Carb/MCU side.
1100 - Called VR Systems and had them try and start remote over the cellular phone. They were able to start the unit.
1200 - Began pulling on Vent Well #2 again @ Approx. 15 to 18 cfm @ ≈ 36" H_2O, System running a little rough due to the high CO_2 content in the soil gas.
1400 - Took photos of the VR Sys. and Ultrox Sys.
1600 - Left Site

S. Archabal 11/17/95

11/18/95 726876.66132 SRI

0745 - Onsite @ Mogas Site, to check on VR System.

0800 - VR System Set Points:

RPM = 1900
Coolant = 146° (Reservoir = Between cold + Hot Full Line)
Oil = 127° (Reservoir = Between Full and 1QT Line)
Exhaust = 1025°
Oil Pressure = 36 psi
Oxy = .611%
Duty Cycle = 45%
Battery = 14.3
Eng. Hrs = 1756
Carb. = 12%
Well Flow = 16 CFM - 18 CFM
Well Valve = 7% - 8%
Well Vac = 36" - 41"
Fuel Flow = 0.6 to 0.8 CFM
Fuel Value = 95%
Total Fuel = 31,708 CF
Propane Tank = 75% Full
Scheduled For: Mon, Wed, Fri - Top-Offs
Water Knockout - No Water.
0900 - Left Site. S. Archabal 11/18/95

12/1/95 726876.66132 SRI

0800 - Onsite @ Mogas Site to check VR system emissions.

0900-1500 Troubleshooting VR System, Found one BAD Plug Wire (#3). Also checked Plugs, Replaced Plugs and Plug Wires. Checked emissions following replacement, Exhaust Hydrocarbon Conc's 0-10 ppmv using Horiba, Running as good as new.

1600: Sampled INF + EFF:

	Canister Vac's
EFF: 1600 #94928	INT = 27.5 "Hg, Final = 0.0" Hg
INF: 1610 #9396	INT = 27.5 "Hg, Final = 1.2" Hg

1630 - Left Site.

rojects (continued)

11-28

Sunny ~ 50°F.

0800 D.Malone arrives on Site. Met Curt Cooley.

0820 Monitored VR System completed check sheet Message: Low oil pressure on 11-17-95. Will call VR Rep.

Warmed TPH O_2/CO_2 Meters

0835 Calibrated meters. TPH on Methane Response

0900 Collected Readings @ Ultrox Unit
Collected Samples
10:08 Ultrox-30800-E
10:08 Ultrox-30800-I

10:45 Relayed data to S. Archabal.

11-21 ~~11-22~~ DM

~~12:15~~
11:45 Steve Indicated
that Ultrox influent
should be boosted
to ~ 1,500 - 1900 pppm.
Try 1,600 ppmv

11:50 Relayed this to
Curt Cooley.
He will check with
Ultrox people About
set-points and talk
to S. Archibal.

12:00 Collected
TPH/O_2/CO_2 data
from VR Unit.
w/ dessicator.
C

12:20 Left site.

MALONE
~~#-00~~

11-30-95

11:00 P. Malone arrived on site
Cold, sunny ; ~ 35°F.

Met Curt Cowley AND
Trainee ~~From~~ Tom Hoover.

VR Unit not operating.
Curt Indicated that
the VR Unit ~~will~~ has
~~operat~~ not operated
since ~ Monday Nov 27.

12:03 Take Ultrox readings
12:20 Calibrate Trace
Techtor w/ 4400 ppmv
hexane.

12:55 Take Ultrox-301500-E
Sample w/ Summa
1307 Take Ultrox-301500-I
Sample w/ Summa

1400 Jump START VR Unit
with VAN

11-30-95 MALONE

1440 S. Archabal indicate to WARM XZ valve with hair dryer

Injected STARTING Fluid into engine carburetor.

~~1830~~

1830 VR unit is running AND stable, left tank drain partially open so VR CAN restart in the event it collects water

left side

12-8-95 DON MALONE

0800 DRMalone arrives on site. Met w/ Tom Hoover.

Cold ~ 35°F partly sunny.

0830 Begin monitoring at Ultrox Unit.

0938 Collect Effluent sample Ultrox - 301500 E

0958 Collect ~~Effl~~ DM Influent Utrox - 301500 I

1030 Begin Monitoring VR Unit. System OK Water in both tanks 50% LP G remaining

1054 Collect VR-205300 - E at Exhaust pipe w/ Copper Tube

1055 Collect VR - 205300 - I at Enternal Sp tank w/ Dessicator Chamber

12-8-95 DON MALONE

12.00 packed sampled and left site for Fed-X

11/18/95 726876.66132 SRA

0745 - Onsite @ Mogas Site, to check on VR System.

0800 - VR System Set Points:

RPM = 1900
Coolant = 146°, (Reservoir = Between Cold + Hot Full Line)
Oil = 127°, (Reservoir = Between Full And Qt Line)
Exhaust = 1025°
Oil Pressure = 36 psi
Oxy = .611%
Duty Cycle = 45%
Battery = 14.3
Eng. Hrs = 1756
Carb. = 12%
Well Flow = 16 CFM - 18 CFM
Well Valve = 7% - 8%
Well Vac = 36" - 41"
Fuel Flow = 0.6 to 0.8 CFM
Fuel Valve = 95%
Total Fuel = 31,708 CF
Propane Tank = 75% Full
Scheduled For: Mon, Wed, Fri - Top-offs
Water Knockout - No Water.
0900 - Left Site. S. Archabal 11/18/95

12/19/95 726876.66132 SRA

0800 - Onsite @ Mogas Site to check VR System emissions.

0900-1500 Troubleshooting VR System, Found one BAD Plug Wire (#3). Also checked Plugs, Replaced Plugs And Plug Wires. Checked emissions following replacement, Exhaust Hydrocarbon Conc's 0-10 ppmv using Horiba, Running As good As New.

1600: Sampled Inf + Eff:

	Canister Vac's
EFF: 1600 #94928	Int = 27.5 "Hg, Final = 0.0" Hg
Inf: 1610 #9396	Int = 27.5 "Hg, Final = 1.2" Hg

1630 - Left Site.

12/20/95 726876.03000 SRA

0800 - On Site @ Mogas Site.
Checked on UR System -
everything operating Fine.
Also, ULTROX System is being
turned OFF TODAY AND will
be packed up FOR Shipment
on 12/22.

1-24-96 D. Malone

Cloudy, Windy.
Chance of thunderstorms
later in the afternoon.

11:00 D. Malone arrives
on site. Opens 4
monitoring points
covers. MP-5 thru MP-8
Connect Magnehelic
gauges. Allow ~
30 sec. before
readings

VAPOR MPOINT	VAC in H_2O	Distance from VW-1
11:20 SV		
(DM) MP-5	4.3	30.6
SV ~~MP~~-6	8.5	11.8'
SV MP-7	8.0	15.3'
SV MP-8	2.8	31.2'

11:40 Warm and calibrate
GasTech (THA) AND
O_2/CO_2 Meters. THA
on full-gas response.

1-24-96 D. MALONE

11:56 Collect soil gas from vpoints in a tedlar bag, using the vacuum chamber/vacuum pump. Collect 5 bags, sample 5th bag

VP	TIME	O_2 (%)	CO_2 (%)	THA (ppm)
~~VP-5~~	~~1209~~	~~13.5~~	~~4.4~~ 3.9	
~~VP-6~~				
~~VP-7~~				
~~VP-8~~				

8

1215 STARTED RAINING w/ Driving Wind. Stop sampling until rain eases

		PM	PM	
VP-5	1320	~~9.5~~	~~4.6~~	>10,000
		12.0	4.2	
VP-6	1334	17.9	1.0	3,100
VP-7	1347	19.7	0.8	1,000
VP-8	1407	20.8	0.5	38

1-24-96 MALONEY

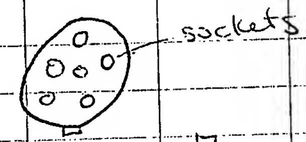
	O_2	CO_2	THA
1447 VR Effluent	Ø.1	8.2	~~2,900~~ 3,100
VR Influent	16.Ø	7.8	2,400

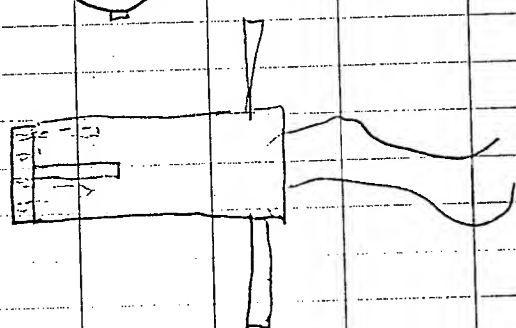
1540 Collected Effluent Summa Sample

1550 Collected Influent VR Sample

1600 Shut-down VR system to drain water from tanks

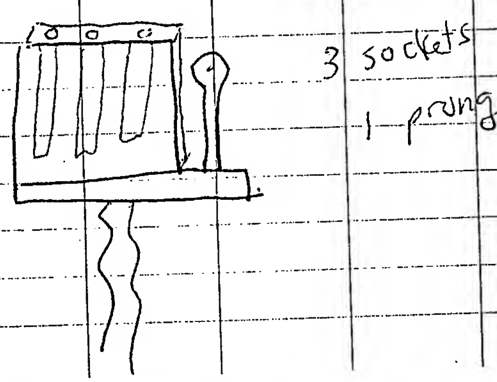
1630 Re-started VR System using start-up procedure





on CORD
CBØØØ1 Rev. A

on trailer:



1-30-96. MALONE

1530 Cloudy ~ 50°F
D. MALONE Arrived on
site. Dismantled VR
system AND removed
from site. Put Well
seal on VW-1.

1630 D. MALONE left site
for Charleston AFB

APPENDIX I

SCREENING AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

TABLE OF CONTENTS

LIST OF TABLES

SCREENING AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

I1.1 OVERVIEW

This appendix identifies a variety of remedial approaches and technologies that were considered in developing remedial alternatives for the MOGAS site at Myrtle Beach Air Force Base (AFB), South Carolina. This initial screening was based on three primary evaluation criteria: effectiveness in meeting South Carolina Department of Health and Environmental Control (SCDHEC, 1995) criteria for risk-based corrective actions, technical and administrative implementability, and relative cost. The purpose of this screening was to quickly focus the Corrective Action Plan (CAP) on the most promising and cost-effective methods for remediating the MOGAS site. This appendix focuses on how selected active remedial technologies could be combined with natural attenuation processes to achieve an effective site cleanup.

I2.1 SCREENING OF REMEDIAL TECHNOLOGIES

Table I.1 provides a summary of the remedial approaches and technologies considered for the MOGAS site. All of these technologies are appropriate for the remediation of fuel-contaminated soils or groundwater. Technologies that are used for non-fuel contaminants have been purposely deleted from this focused initial screening. Several of the most promising technologies considered during screening were retained as candidates for the development of remedial alternatives and are evaluated in Section 9 of the CAP. The following paragraphs provide a brief description of each approach or technology group and its applicability at the MOGAS site.

I2.1.1 Long-Term Soil, Soil Gas, and Groundwater Monitoring

Long-term monitoring of soil, soil gas, and groundwater is essential for evaluating the progress of intrinsic and engineered remediation of contaminated media and for ensuring that cleanup criteria are achieved over a specified time interval. Monitoring results can be used to support site closure or to justify the need for continued remediation.

I2.1.1.1 Soil and Soil Gas Monitoring

Soil and soil gas monitoring provides information for assessing the effectiveness of an implemented soil remedial technology. Extensive soil sampling at the MOGAS site has revealed elevated contaminant levels in unsaturated and saturated soils in the vicinity of the former UST locations. All detected soil contaminant concentrations are below target risk-based remedial goals for direct contact that are protective of human health given current and future proposed land uses. Soil gas monitoring can be used to indicate volatile organic compound (VOC) reduction, and oxygen and carbon dioxide concentrations can indicate the level of hydrocarbon biodegradation occurring in the soil. Long-term soil and soil gas monitoring was retained for further evaluation.

TABLE I.1
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUNDWATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
Long-Term Monitoring	Periodic Groundwater/ Surface water	Groundwater monitoring wells, surface water sampling stations	Existing wells are available to confirm the progress of remediation.	Necessary component of all remediation strategies	Low	Yes
	Monitoring	Groundwater monitoring wells, surface water sampling stations	Additional wells could be installed south of the drainage ditch if plume underflow is significant.	Necessary component of all remediation strategies	Low	Yes
	Periodic Soil/Soil Gas Monitoring	Installation of Additional Soil Boreholes	Soil sampling and soil gas monitoring useful for checking remediation progress. Both options are readily implementable.	Additional soil sampling necessary in future to document decrease in concentrations of chemicals of potential concern.	Low	Yes
Institutional Controls	Land and Groundwater Use Control	Land Use Control/Regulate Well Permits	Plume area is currently within the Base boundary. Land and ground water use are under Base jurisdiction. Use restrictions can be implemented during property transfer resulting from Base closure.	Necessary component of risk-based cleanup	Low	Yes
		Seal/Abandon Existing Wells	No impacts to deep Base drinking water wells have been documented. Use of these wells will be discontinued as a result of Base closure.	Not required at this site	Low	No
		Point-of-Use Treatment	No impacts to deep Base drinking water wells have been documented. Use of these wells will be discontinued as a result of Base closure.	Poor	Moderate	No

TABLE I.1 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUND WATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
Institutional Controls (Cont'd)	Public Education	Meetings/ Newsletters	Important to convey a clear understanding of acceptable land and groundwater use.	Necessary	Low	Yes
Containment of Plume	Hydraulic Controls	Interceptor Trench Collection	Thin saturated zone and shallow aquitard would facilitate construction and enhance effectiveness. Less expensive, *in situ* interception/treatment methods could adequately prevent discharge of contaminated groundwater to ditch.	High	High	No
		Minimum Pumping/Gradient Control	Thin saturated zone and shallow aquitard would facilitate construction and enhance effectiveness. Pumping would lower water table and aerate contaminated intervals below the average water table, allowing them to be affected by *in situ* bioventing or SVE	High	High	Yes
	Physical Controls	Slurry Walls/Grout Curtains	Requires significant disruption. Limited effectiveness.	Moderate	High	No
		Sheet Piling	Requires significant disruption. Limited effectiveness.	Moderate	High	No

TABLE I.1 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUND WATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
In Situ Groundwater Treatment	Biological	Oxygen and/or Nutrient Enhanced Biodegradation (Biosparging)	Differs from biologically active zone in that oxygen (air) is injected within or upgradient from plume and allowed to migrate downgradient. In theory, this method can more rapidly reduce higher BTEX/PAH concentrations in and immediately downgradient of the source.	Moderate	Low	Yes
		Oxygen-Release Compound	Oxygen-release compound can be hung in wells or mixed with excavation backfill material to enhance dissolved oxygen concentrations and aerobic biodegradation rates. May require replacement/renewal after several months of use.	High	Moderate to High	Yes
	Chemical/Physical	Natural Attenuation	A combination of natural biological, chemical, and physical removal mechanisms which occur to varying degrees on every site. Groundwater sampling at the MOGAS site indicates that this is an ongoing remediation process. Available data indicate that this process should be supplemented by more active remediation.	Low	Low	Yes

TABLE I.1 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF
TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUND WATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
In situ Groundwater Treatment (Cont'd)		Air Sparging (volatilization)	Injection of air into contaminated aquifer creating a mass transfer of contaminants into air bubbles and into vadose zone. Limited radius of influence and short-circuiting are common problems, but a sparge curtain north of the drainage ditch could decrease discharge of contaminants.	Moderate	Low	Yes
Ex Situ Groundwater Treatment	Biological	Bioreactors	High contaminant concentrations require excessive retention times and bioreactors typically require a high degree of maintenance. BTEX is often volatilized in these systems.	Moderate	High	No
	Chemical/Physical	Air Stripping	Cost-effective technology for removing varying concentrations of BTEX at higher flow rates and longer durations. Flow rate at the MOGAS site are anticipated to be low.	High	High	No
		Activated Carbon	Cost effective for low flow rates and/or more dilute concentrations of BTEX/PAHs. Creates a carbon disposal issue.	High	Moderate due to anticipated low flow rates	Yes
		UV/Ozone Reactors	High contaminant concentrations require excessive retention times and large, expensive reactors.	Moderate	High	No

TABLE I.1 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUND WATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
Ex Situ Groundwater Treatment (Cont'd)		Direct Discharge to Industrial Waste Water Treatment Plant (IWWTP)	Viable option when an IWWTP is available and capable of handling BTEX/PAHs and hydraulic loading. IWWTP is not available, and contaminant concentrations are unacceptably high for discharge to a municipal WWTP.	High	High	No
Treated Groundwater Disposal	Discharge to Industrial Wastewater Treatment Plant (IWWTP) or Sanitary Sewer	IWWTP	Viable option when an IWWTP is available and capable of handling BTEX/PAHs and hydraulic loading. IWWTP not available.	High	High	No
		Sanitary Sewer	Viable option when access to sanitary sewer exists and hydraulic loading is acceptable. Sanitary sewer access is available at the site.	High	Low when sewer available	Yes
	Treated Groundwater	Vertical Injection Wells	Not recommended due to potential for clogging and high maintenance. Permits required.	Moderate	High	No
	Reinjection	Injection Trenches	Requires large trenches and can be subject to clogging, high maintenance, and injection well permitting.	Moderate	High	No

TABLE I.1 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUND WATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
Treated Groundwater Disposal (cont.)	Discharge to Surface Waters	Storm Drains	Viable option but generally requires NPDES or other discharge permit. Storm drain not readily available. Direct discharge to drainage ditch may be feasible but may require environmental impact assessment.	High	Moderate Permitting Costs	No
Source Reduction/Soil Remediation	Free Product Recovery	Dual-Pump Systems	Best suited for sites with >1 foot free product where aboveground groundwater treatment exists. Recoverable free product not observed at site.	Low	High	No
		Skimmer Pumps/Bailers/ Wicks	Best suited for sites with <1 foot free product where groundwater pumping is undesirable. Recoverable free product not observed at site.	Low	High	No
		Total Fluids Pumping	Best suited for sites with thin saturated zones where excessive groundwater will not be pumped. Recoverable free product not observed at site.	Low	High	No
		Bioslurping	Combined vapor extraction, bioventing, and free product recovery system has been operated at some sites with success. Recoverable free product not observed at site.	Low	Intermediate	No
	Excavation/Soil Treatment	Excavation	Implementable, but would generate excessive volume of soil for treatment and/or disposal. Some asphalt removal would be required.	High	High	No

TABLE I.1 (Continued)
INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL AND GROUND WATER REMEDIATION
MOGAS SITE CORRECTIVE ACTION PLAN
RISK-BASED APPROACH TO REMEDIATION
MYRTLE BEACH AFB, SOUTH CAROLINA

General Response Action	Technology Type	Process Option	Technical Implementability	Effectiveness in Attaining Target Remedial Goals	Relative Cost	Retain
Source Reduction/Soil Remediation (cont.)	Excavation/Soil Treatment (cont'd)	Biological Landfarming	Base closure and property transfer may complicate the implementation of this option. Excavation not retained.	Moderate	Moderate	No
		Thermal Desorption	Excavation not retained.	Moderate	High	No
	In Situ	Bioventing	Bioventing would be successful at MOGAS site based on pilot test results.	High	Low	Yes
		Soil Vapor Extraction (SVE)	Vapor extraction would be successful at MOGAS site based on pilot test results; however, off-gas treatment will probably be required.	High	High due to off-gas treatment	Yes
		Soil Washing	Additional pore volumes of water and/or surfactant solution are forced through aquifer material to enhance the partitioning of hydrocarbons into the groundwater. May promote contaminant mobility, and creates special above ground treatment problems.	Moderate	High	No
Surface Water Remediation	*In Situ*	Surface Water Sparging	The same blower used for the SVE/air sparging system could be used to inject air into drainage ditch surface water downstream from the MOGAS site.	High	Low	Yes

I2.1.1.2 Groundwater/ Surface Water Monitoring

Groundwater/ surface water monitoring is essential for evaluating the effectiveness of implemented groundwater remediation technologies, including natural attenuation processes. Groundwater monitoring wells can be utilized to monitor chemicals of concern and their attenuation within and near the existing plume. The predictions of fate and transport models are often verified using sentry wells within the plume. Groundwater monitoring wells can be sampled at downgradient locations south of the drainage ditch to ensure that contaminant underflow beneath the ditch does not occur to a significant degree, and to ensure that contaminants do not advance at concentrations that may present an unacceptable risk beyond an area under reliable exposure controls. Surface water sampling locations can be regularly sampled to ensure that benzene contamination is not flowing past Third Street, west of the site. The suitability of existing groundwater monitoring wells and surface water sampling stations for monitoring site contamination is addressed in Section 10 of the CAP, the Long-Term Monitoring Plan. Long-term groundwater and surface water monitoring was retained as a key component of the remedial alternatives for this site.

I2.1.2 Land and Groundwater Use Controls

Some degree of land and groundwater use control will be required if contaminant concentrations in groundwater at the MOGAS site exceed health-based SSTLs. Land and groundwater use controls can be enacted to minimize the potential for direct receptor contact with site contamination.

I2.1.2.1 Land Use Controls

Physical barriers and deed restrictions/easements can be used to control land use. Access to this site is currently limited by fencing around the Base perimeter and a portion of the site, as well as controlled access to all Base areas. Physical barriers and deed restrictions on land and resource uses were retained for further evaluation.

I2.1.2.2 Groundwater Use Controls

Groundwater use controls can eliminate the possibility of direct exposure of site workers to contaminated groundwater. Groundwater use can be controlled by regulating well permits, minimizing excavations below the water table, and, when no other source of drinking water is available, installing point-of-use treatment systems. Contaminated groundwater at this site remains within an area under Base control, and active drinking water wells at the Base are screened in a deeper aquifer that should not be affected by shallow contamination. The regulation of future well permits in the vicinity of the MOGAS site was retained for further evaluation.

I2.1.3 Public Education

At many contaminated sites, public education is required to inform the public of the potential risks associated with site contamination and to provide the necessary warnings to prevent unintentional contact with site soils or groundwater. Although no human health risk is currently associated with this site (provided adequate exposure controls are maintained: PPE, no excavation, prevention of trespasser/recreator contact with site

contaminated media), any future release of this property to private citizens or business should be accompanied with a clear understanding of where fuel contamination may still exist and the appropriate land uses that will prevent exposure. Public education was retained as a remedial approach.

I2.1.4 Containment of the Groundwater Plume

Plume containment uses either hydraulic controls, such as limited groundwater pumping, or physical barriers such as slurry walls, to minimize downgradient plume migration. This strategy is most often used to halt the advance of highly contaminated groundwater before it impacts downgradient drinking waters or surface waters.

I2.1.4.1 Hydraulic Controls

Hydraulic controls are used to extract contaminated groundwater to prevent further migration of the plume. Hydraulic controls considered for the MOGAS site include a groundwater interceptor trench and extraction wells. The objective of hydraulic controls at this site would be to prevent discharge of contaminated groundwater to the southern drainage ditch and, at the same time, extract contaminated groundwater for *ex situ* treatment/disposal. Groundwater extraction would lower the water table, exposing contaminated zones that are below the average water table and facilitating their remediation by concurrent bioventing or SVE. The extracted groundwater would be treated aboveground by air stripping or carbon treatment and discharged to the ditch or a sanitary sewer. This approach could provide a conservative margin of protection against plume migration and would constitute a relatively aggressive remedial alternative. Therefore, groundwater pumping to lower the water table and capture dissolved contaminants before they discharge to the drainage ditch at the MOGAS site was retained as a remedial option.

I2.1.4.2 Physical Groundwater Barriers

Slurry walls, grout curtains, and sheet piling are physical structures capable of limiting downgradient dissolved contaminant migration. However, contaminants are not removed by such physical barriers; they are only contained. When compared to an interceptor trench where contaminants are contained and removed, containment alone is a less effective option. Additionally, installation of a physical barrier along the northern bank of the ditch may cause mounding and discharge of contaminated groundwater to the ground surface and/or migration of contaminants around the barrier. For these reasons, physical groundwater barriers were not retained for further consideration.

I2.1.5 *In situ* Groundwater Treatment

In situ treatment includes both engineered and natural processes which are capable of destroying or immobilizing dissolved contamination in place. *In situ* treatment is generally less expensive than aboveground treatment because there is no need to extract, treat, and then dispose of groundwater or soil.

I2.1.5.1 Natural Attenuation

As discussed in Section 6 of the CAP, natural attenuation takes advantage of destructive and nondestructive attenuation mechanisms to bring about a net reduction in groundwater contaminant concentrations. Destructive attenuation mechanisms include biodegradation, abiotic oxidation, and hydrolysis. Nondestructive attenuation mechanisms include sorption, dilution, and volatilization (Wiedemeier *et al.*, 1994). Geochemical evidence indicates that natural attenuation is an ongoing cleanup process at this site. Therefore, this remedial approach was retained for further consideration.

I2.1.5.2 Enhanced/Active Biological Groundwater Treatment via Biosparging

Enhanced *in situ* biodegradation takes advantage of natural biological processes by providing enhanced electron acceptor conditions and, when required, enhanced nitrogen/phosphorus (i.e., nutrient) conditions to stimulate microbial growth and more rapid biodegradation. Section 6 of the CAP provides geochemical evidence that low oxygen concentrations in groundwater at the MOGAS site may be limiting the biodegradation of dissolved contaminants in the plume. Low flow-rate air injection into groundwater, known as biosparging, can be used to increase dissolved oxygen concentrations in groundwater and promote biodegradation. Biosparging was retained for evaluation as a method of enhancing natural biodegradation in the source area and diminishing discharge of contaminants to the ditch.

I2.1.5.3 Enhancement of Aerobic Biodegradation using an Oxygen-Release Compound

Commercially available oxygen-release compounds (e.g. ORC® manufactured by <u>REGENESIS</u> Bioremediation Products) can be installed in wells or mixed with backfill materials and added to trenches or backhoe pits to enhance DO concentrations and facilitate aerobic biodegradation of fuel hydrocarbons dissolved in groundwater. Linear trenches or lines of closely spaced wells containing an oxygen-release compound can be used to create a plume containment barrier similar to an air sparging curtain. Case studies have indicated that an oxygen-release substance may need to be replaced at intervals of several months to maintain significantly elevated DO concentrations in the groundwater; therefore, use of wells that would enable periodic retrieval of the oxygen-release substance would be desirable at the MOGAS site. DO concentrations within the dissolved BTEX plumes at the MOGAS site are low, and enhancement of these concentrations would stimulate aerobic biodegradation processes. Therefore, use of an oxygen-release compound was retained for further consideration.

I2.1.6 *Ex Situ* Groundwater Treatment

Groundwater extraction with *ex situ* groundwater treatment offers the flexibility of more engineering controls than *in situ* remediation, and can usually treat a wider range of contaminants than *in situ* treatment. Groundwater extraction also provides greater control over plume migration and can be focused in areas of greatest contamination. As discussed in Section I2.1.4.1 of this appendix, active groundwater extraction techniques were retained for further evaluation. As a result, *ex situ* groundwater treatment technologies are discussed below.

Treatment technologies most appropriate for removing dissolved hydrocarbons from extracted groundwater include air stripping methods, activated carbon adsorption, and bioreactors. Treatment facility construction, operation, maintenance, and monitoring will require greater financial resources. Pump installations and maintenance also add to the cost of this technology group.

I.2.1.6.1 Air Stripping

Air stripping technologies contact contaminated groundwater with clean air to volatilize (strip) dissolve contaminants from the aqueous phase. Air stripping is most effective for compounds with Henry's Law constants greater than 0.001, including benzene, toluene, ethylbenzene, and xylenes, which have Henry's Law constants of 0.0054, 0.0066, 0.0079, and 0.0049-0.007, respectively. The highest total BTEX concentration measured in the source area in August-September 1995 was 47,300 µg/L at well MW-112. The average total BTEX concentration measured in the four most contaminated wells in the source area was approximately 25,000 µg/L. These concentrations are expected to decrease rapidly during the first few months of groundwater extraction as BTEX contamination in soils is remediated via bioventing or SVE. In addition, preliminary simulations of the pump-and-treat system using Bioplume II indicate that adequate drawdown and plume capture could be achieved using 3 wells pumping less than 5 gallons per minute (gpm) each. Due to the anticipated low flow rates and rapid decrease in contaminant concentrations in the extracted groundwater, activated carbon alone should provide the most cost-effective treatment option (see below). Air stripping would also release VOCs to the atmosphere and may require expensive off-gas treatment. Therefore, air stripping was not retained as a process option.

I.2.1.6.2 Activated Carbon

Activated carbon is a commonly used method of removing BTEX contaminants from groundwater as it passes through a packed-bed canister of granular activated carbon (GAC). Due to the increasingly dilute concentrations of all dissolved COPCs expected if groundwater is extracted at the MOGAS site, activated carbon would provide relatively inexpensive and low maintenance treatment of extracted groundwater. Activated carbon is also capable of reducing all COPCs to levels below generic South Carolina RBSLs, which is important for satisfying discharge requirements. Activated carbon was retained as an aboveground treatment technology if groundwater extraction is selected as a site remedy.

I.2.1.6.3 Bioreactors

Bioreactors typically provide an enhanced environment where biodegradation rates are higher than those observed *in situ*. The *ex situ* nature of the bioreactor allows for greater control of reactor conditions (e.g., temperature, pH, mixing) and some optimization of degradation pathways. The hydraulic loading of bioreactors is often limited because complete biodegradation requires long retention times to degrade high concentrations of hydrocarbons. In the case of slower degrading PAHs, the contaminants must first be adsorbed to filter media and retained to complete the biodegradation process. Due the typically high maintenance requirements of bioreactors and the potential need for long retention times to adequately treat the

(initially) high dissolved contaminant concentrations in the extracted groundwater, this technology was not recommended for further consideration.

I.2.1.7 Treated Groundwater Discharge/Disposal

The extraction and treatment of contaminated groundwater will require a method of disposal for treated water which meets all appropriate discharge standards of the State of South Carolina and the USEPA. Several methods of onsite and offsite disposal were identified for this initial screening.

I.2.1.7.1 Direct Discharge to IWWTP

Direct discharge of extracted, contaminated groundwater to an industrial wastewater treatment plant (IWWTP) is an alternative for treatment if a treatment plant is available and can accept fuel-tainted waters. An IWWTP is not available at the Base, and the high concentrations of dissolved contaminants would make discharge to a municipal WWTP unacceptable. Direct discharge to a IWWTP or municipal WWTP was not retained for further evaluation.

I.2.1.7.2 Discharge to Sanitary Sewer

A sanitary sewer line can be accessed near Building 507, located approximately 70 feet east of the former eastern UST location. Therefore, discharge to a sanitary sewer is feasible at the MOGAS site. The permitting requirements of the Myrtle Beach sewer authority would have to be determined, and samples of the discharged water would have to be collected and analyzed periodically to confirm that water quality requirements are being met.

I.2.1.7.3 Reinjection to Groundwater

Reinjection of treated groundwater into the subsurface can be accomplished through several methods. Surface application using a sprinkler system would be feasible, but the unpaved, grassy area at the site is limited, and runoff of irrigation water into the drainage ditch may occur. Therefore, this option was not retained for further consideration. Reinjection wells have been used to return treated groundwater to the subsurface; however, injection wells require frequent maintenance to reduce the impacts of plugging, which almost always occurs over time. The preferred method of reinjection for this site would be the construction of a large reinjection trench upgradient from the source area. These trenches generally contain a large-diameter, perforated pipe and are filled with gravel. Reinjection trenches are less likely to become fouled by inorganic precipitates and biogrowth because they can be constructed with much larger surface area to flow ratios when compared to injection wells. Reinjection trenches were not retained as an option for the discharge of treated groundwater due to the proximity of a sanitary sewer and the relative simplicity of sewer disposal.

I.2.1.7.4 Discharge to Surface Drainage

Under this option, treated groundwater would be discharged into the drainage ditch that forms the southern boundary of the MOGAS site. As described in Section 3.3 of

the CAP, this ditch discharges into the Intracoastal Waterway approximately 2 miles north of the site. A discharge permit and frequent monitoring would be required to ensure protection of the ditch ecosystem and downstream receptors. It is possible that an environmental assessment (EA) also would be required before a discharge permit was granted. The permitting and monitoring requirements for discharge to the nearby sanitary sewer are most likely simpler and less expensive than for surface water discharge; therefore, this option was not retained for further evaluation.

I2.1.8 Source Reduction/Soil Remediation Technologies

The removal or reduction of concentrated contaminants in the source area is normally an important element of a comprehensive site remediation. Two primary sources of contamination can potentially exist at fuel contaminated sites: mobile light non-aqueous-phase liquid (LNAPL), or free--phase product, and residual fuels which are sorbed or occluded within the soil matrix. A fuel sheen has been observed in limited areas at the MOGAS site, but recoverable volumes of mobile LNAPL do not appear to be present. Residual fuels constitute the primary contaminant source at the MOGAS site.

Residual fuel contamination at this site appears to be present beneath and immediately adjacent to the former underground storage tank (UST) locations, and along corridors between the UST locations and the drainage ditch. The most elevated contaminant concentrations are generally present within 3 feet above and below the water table (approximately 7 to 13 feet bgs). Analysis of soil samples indicate that remaining concentrations of benzene, toluene, ethylbenzene, naphthalene, chlorobenzene, and 1,3,5-trimethylbenzene (TMB) are above Tier 1 risk-based soil leaching criteria that are protective of groundwater. Soil vapor quality analytical indicate that contaminated vadose zone soils are a significant source of soil gas contamination at the MOGAS site, and the results also represent a significant source of groundwater contamination in unpaved areas where infiltration of precipitation can cause contaminant leaching. Common soil remediation technologies such as soil vapor extraction (SVE) and *in situ* bioventing, which depend on soil gas movement, should be effective due to the permeable nature of the sands found in the subsurface at the MOGAS site. Soil flushing using surfactants is another option for reducing fuel residuals that is evaluated in this section.

I2.1.8.1 Soil Vapor Extraction

SVE mechanically withdraws soil vapor from the vadose zone to the surface using vent wells. If necessary, offgas can be treated prior to discharge into the atmosphere. By extracting soil vapor from the vadose zone, the desorption of VOCs from soils into soil gas is enhanced. SVE is very effective in permeable soil such as the sands present at shallow depths at this site. Because SVE also results in an influx of oxygenated soil gas from clean soils, it also enhances the biodegradation of less volatile hydrocarbons. A 3-month SVE pilot test conducted at the MOGAS site is described in Section 8 of the CAP. SVE was retained for further evaluation in the event that further SVE is deemed to be necessary to reduce VOC concentrations in the vadose zone.

I2.1.8.2 Bioventing

Bioventing is mechanically similar to SVE except that this technology uses much lower rates of air injection to provide the necessary oxygen to sustain biological degradation. Bioventing rates of air injection are typically one-tenth of vapor extraction rates for the same site. The effectiveness of this technology has been demonstrated in a major pilot testing program conducted at over 140 Air Force sites (Downey, 1994). An air respiration test conducted at the MOGAS site is described in Section 8 of the CAP. Once SVE has reduced soil gas concentrations to acceptable levels, bioventing could be implemented as a low-cost remedial technique for treatment of residual soil contamination. *In situ* bioventing was retained for further analysis.

I2.1.8.3 Surfactant Soils Washing

Soil washing is used to enhance the natural partitioning of contaminants from the soil into the groundwater, and is generally associated with a groundwater extraction system. The more strongly sorbed compounds may require surfactant soil washing to facilitate the dissolution process. *In situ* soil washing is only effective in more permeable aquifer materials, such as those at the MOGAS site. Soil washing usually involves the addition of a surfactant compound that has a nonpolar "tail" to dissolve the contaminant, and a polar end so that the formed miscelle is soluble in water. Biodegradable surfactants are desirable to ensure that new recalcitrant chemicals are not introduced into the aquifer.

Two significant disadvantages are associated with this technology. Because surfactants are added in relatively high concentrations, they will exert a significant biological oxygen demand on the aquifer. This additional organic loading may exceed the natural assimilative capacity of the aquifer, thereby promoting the migration of both surfactant and fuel hydrocarbons. The second problem is that when the surfactant solution is recovered, it is difficult to separate contaminants from the surfactants so that surfactants can be recycled. Treatment of surfactant-laden groundwater can be achieved with activated carbon, but the surfactant will rapidly load the carbon, resulting in high treatment costs. Due to these technical difficulties, surfactant soils washing was not retained for further evaluation.

I2.1.9 Soil Excavation and Treatment

Some excavation of contaminated soils has already been performed in conjunction with the removal of the USTs. As described in Section I2.1.7, the majority of the soil contamination is not near the ground surface; therefore, a substantial volume of relatively uncontaminated soils would have to be excavated to expose the most contaminated interval, and some asphalt pavement would have to be removed. Treatment of these deeper soils by *in situ* methods such as SVE and bioventing would obviate the need to excavate large quantities of soils that would require treatment and/or disposal, and would be less expensive than excavation. For these reasons, excavation and aboveground soil treatment options such as biological treatment or thermal treatment were not retained for further evaluation.

I2.1.10 Surface Water Sparging

Surface water sparging could be performed in the event that implementation of a biosparging system (Section I2.1.5.2) does not prevent significant concentrations of dissolved VOCs from discharging to the drainage ditch. Surface water sparging would consist of air injection into surface water downstream from the MOGAS site (e.g., immediately west of Third Street where the ditch widens and the average surface water flow rate decreases). The same blower used for the bioventing/biosparging system could conceivably be used to perform the surface water sparging. This option was retained for further consideration.

I3.1 SUMMARY OF RETAINED REMEDIAL TECHNOLOGIES

Based on the initial technology screening discussed in Section I2 of this appendix and summarized in Table I.1, several remedial approaches and technologies have been retained for the development of remedial alternatives and more detailed analysis. These technologies were selected to provide a range of passive to more active response actions, all of which can meet SCDHEC (1995) cleanup criteria for risk-based corrective actions, and maintain contaminant concentrations that are protective of human health and the environment in an industrial setting. The following remedial approaches and technologies have been retained :

- Long-term soil gas, groundwater, and surface water monitoring;
- Limited land use controls;
- Groundwater use controls;
- Public education;
- Natural attenuation of soil, groundwater, and surface water contamination;
- Biosparging in the source area and near the drainage ditch with concurrent, incidental bioventing of the vadose zone;
- Installation of a plume containment barrier near the drainage ditch using an oxygen-release compound;
- SVE in the source area;
- Groundwater extraction with aboveground carbon treatment and sanitary sewer disposal of treated groundwater; and
- Surface water sparging.

Because natural attenuation processes (specifically biodegradation) have been removing dissolved fuel contaminants from the groundwater, this ongoing remediation process can only be enhanced through a reduction of both residual soil contamination that is acting as a source of contamination to groundwater and of more concentrated dissolved BTEX between the source area and the drainage ditch. Three candidate

source reduction plume containment technologies, including biosparging with concurrent, incidental bioventing, SVE, and limited groundwater extraction have been retained for additional analysis. Each of these remediation approaches is described in greater detail, and their effectiveness is evaluated in Section 9 of this CAP.

I4.1 REFERENCES

Downey, D.C. 1994. Bioventing Performance and Cost Summary. Proposal for Air Force Center for Environmental Excellence, Brooks Air Force Base, San Antonio, Texas. July.

SCDHEC. 1995. Risk-Based Corrective Action For Petroleum Releases. June.

Wiedemeier, T.H., J.T. Wilson, D.H. Kambell, R.N. Miller. 1994. US Air Force Guidelines for Successfully Supporting Intrinsic Remediation with an Example from Hill AFB. Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Groundwater Conference. Houston, TX. Pp 317-335.

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Capital Costs

Biosparging Pilot Test Performance

Pilot Test Workplan				$4,000
Pilot Test Kit Rental				
(blower, accessories, etc.)	5 days x	$500	/day	$2,500
Labor	112 hours	$70	/hour	$7,840
Per Diem	14 days	$136	/day	$1,904
Mob/Demob/Data Analysis	80 hours	$70	/hour	$5,600
Travel (1 tround trip from Denver @ $1500 and one trip from Cary @ $300)		$1,800	lump sum	$1,800
Misc. Supplies			lump sum	$500
Contingency (10%)				$2,414
			Subtotal	$26,558

Installation of the 66-Well Biosparging System

Design/Procure/Install System	540 hours x	$70	/hour	$37,800
Blower/Shed/Accessories		$16,000	lump sum	$16,000
Asphalt Cutting/ Well point Installation/trenching		$20,000	lump sum	$20,000
Electrical Subcontractor		$5,000	lump sum	$5,000
Per Diem	70 days x	$136	/day	$9,520
Travel		$6,000	lump sum	$6,000
Geprobe Rental (3 weeks)		$6,000	lump sum	$6,000
O & M Manual Preparation	40 hours x	$60	/hour	$2,400
Contingency (10%)		$10,272	lump sum	$10,272
			Subtotal	$112,992

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Future Costs

Confirmatory Soil Sampling at 4 Locations

Sampling Labor	80 hours x	$60	/hour	$4,800
8 Soil Samples				
1 QA/QC				
9 Total Samples				
Analytical Subcontractor				
	9 BTEX x	$85	/each	$765
	9 Naphthalene x	$240	/each	$2,160
Geoprobe Rental	2 days x	$500	/day	$1,000
Supplies		$500	lump sum	$500
Travel		$1,500	lump sum	$1,500
Per Diem	4 days x	$136	day	$544
Office ODC		$300	lump sum	$300
Contingency (10%)		$1,157	lump sum	$1,157
		Total Future Cost		$12,726

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual and Operational Costs

Soil Gas Sampling/ Respiration Testing at 6 Locations - Semiannually

Soil Gas Analysis (EPA TO-3)	6 samples x	$130	/sample	$780
Sampling Labor	64 hours x	$60	/hour	$3,840
Sample Shipping		$250	lump sum	$250
Per Diem	8 days x	$136	/day	$1,088
Travel		$1,500	lump sum	$1,500
Equipment Rental (Meters)		$500	lump sum	$500
Progress Report	20 hours x	$70	/hour	$1,400
Contingency (10%)		$936	lump sum	$936
			Subtotal	$10,294
	Total for 1 year (two sampling events)			$20,588

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Groundwater and Surface Water Sampling - Quarterly (1 year), Semiannually (5 years)

Sampling Labor	80 hours x	$60	/hour	$4,800
10 Long-Term Monitoring Wells				
4 Surface Water Samples				
2 QA/QC				
16 Total Samples				
Analytical Subcontractor				
	16 BTEX x	$90	/each	$1,440
	10 Naphthalene x	$200	/each	$2,000
	10 Methane	$86	/each	$860
	16 Field Parameters	$20	/each	$320
Supplies		$500	lump sum	$500
Travel		$1,500	lump sum	$1,500
Per Diem	10 days x	$136	day	$1,360
Office ODC		$300	lump sum	$300
Contingency (10%)		$1,308	lump sum	$1,308
			Subtotal	$14,388
			Total for 1 Year of Quarterly Sampling	$57,552
			Total for 1 Year of Semiannual Sampling	$28,776

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Operation and Maintenance of the Biosparging System - 6 trips per year

System Monitoring				
Monitoring Labor	120 hours x	$60	/hour	$7,200
Travel		$1,200	lump sum	$1,200
Per Diem	12 days x	$136	/day	$1,632
Equipment Rental		$1,200	lump sum	$1,200

Electrical Usage
2 x 5 hp x 745.7 watts/hpr= 7457 watts
746 watts = .746 kilowatts
7.457 kilowatts x 365 days x 24 hrs/day = 65,323 kw
65323 kw x $0.06/kw = $3,919

				$3,919
		Annual O&M Cost		$15,151
Site Management - per year	100 hrs/yr x	$60	/hour	$6,000

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Summary of Capital Costs and 1st Year of Operation

Biosparging System Pilot Test		$26,558
Installation of the 66-Well Biosparging System		$112,992
Groundwater/ Surface Water Sampling Quarterly for first year		$57,552
Soil Gas Sampling/ Respiration Testing at 6 Locations for First year		$20,588
Site Managment for first year		$6,000
Annual O&M Cost		$15,151
	Total Capital Costs	$238,842

Remedial Alternative 1 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

<u>Annual Costs</u>

Groundwater/ Surface water Sampling Semiannually for 5 years

		Annual Cost	$28,776
	P/A i=7%, n=5	PWF = 4.10019744	
		Present Worth Cost	$117,987
	Groundwater sampling Present Worth Cost		$117,987

Biosparging System Maintenance (3 years)

		Annual Cost	$15,151
	P/A i=7%, n=3	PWF = 2.62431604	
		Present Worth Cost	$39,762

Soil Gas Sampling Semiannually for three years

		Annual Cost	$20,588
	P/A i=7%, n=3	PWF = 2.62431604	
		Present Worth Cost	$54,028

Site Management every year (5 years)

		Annual Cost	$6,000
	P/A i=7% n=5	PWF = 4.10019744	
		Present Worth Cost	$24,601

<u>Future Costs</u>

Present Worth of Confirmatory Soil Sampling — $9,709
P/F i=7% n=4

Total Present Worth of Annual Costs = $236,379

Total Cost Estimate of Proposed Corrective Action = $484,929

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Capital Costs

Biosparging Pilot Test Performance

Pilot Test Workplan				$4,000
Pilot Test Kit Rental				
(blower, accessories, etc.)	5 days x	$500	/day	$2,500
Labor	112 hours	$70	/hour	$7,840
Per Diem	14 days	$136	/day	$1,904
Mob/Demob/Data Analysis	80 hours	$70	/hour	$5,600
Travel (1 tround trip from Denver @ $1500 and one trip from Cary @ $300)		$1,800	lump sum	$1,800
Misc. Supplies			lump sum	$500
Contingency (10%)				$2,414
			Subtotal	$26,558

Installation of the 47-Well Biosparging System

Design/Procure/Install System	450 hours x	$70	/hour	$31,500
Blower/Shed/Accessories *(assume use of 2 HP blower instead of 5 HP as in Alternative 1)*		$8,000	lump sum	$8,000
Asphalt Cutting/ Well point Installation		$4,000	lump sum	$4,000
Electrical Subcontractor		$2,500	lump sum	$2,500
Per Diem	58 days x	$136	/day	$7,888
Travel		$6,000	lump sum	$6,000
Geoprobe Rental (2 wks)		$4,000	lump sum	$4,000
O & M Manual Preparation	40 hours x	$60	/hour	$2,400
Contingency (10%)		$6,629	lump sum	$6,629
			Subtotal	$72,917

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Future Costs

Confirmatory Soil Sampling at 4 Locations

Sampling Labor 8 Soil Samples 1 QA/QC 9 Total Samples	80 hours x	$60	/hour	$4,800
Analytical Subcontractor				
	9 BTEX x	$85	/each	$765
	9 Naphthalene x	$240	/each	$2,160
Geoprobe Rental	2 days x	$500	/day	$1,000
Supplies		$500	lump sum	$500
Travel		$1,500	lump sum	$1,500
Per Diem	4 days x	$136	day	$544
Office ODC		$300	lump sum	$300
Contingency (10%)		$1,157	lump sum	$1,157
		Total Future Cost		$12,726

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual and Operational Costs

Soil Gas Sampling/ Respiration Testing at 6 Locations - Semiannually

Soil Gas Analysis (EPA TO-3)	6 samples x	$130	/sample	$780
Sampling Labor	64 hours x	$60	/hour	$3,840
Sample Shipping		$250	lump sum	$250
Per Diem	8 days x	$136	/day	$1,088
Travel		$1,500	lump sum	$1,500
Equipment Rental (Meters)		$500	lump sum	$500
Progress Report	20 hours x	$70	/hour	$1,400
Contingency (10%)		$936	lump sum	$936
			Subtotal	$10,294
	Total for 1 year (two sampling events)			$20,588

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Groundwater and Surface Water Sampling - Quarterly (1 year), Semiannually (5 years)

Sampling Labor	80 hours x	$60	/hour	$4,800
10 Long-Term Monitoring Wells				
4 Surface Water Samples				
2 QA/QC				
16 Total Samples				
Analytical Subcontractor				
	16 BTEX x	$90	/each	$1,440
	10 Naphthalene x	$200	/each	$2,000
	10 Methane	$86	/each	$860
	16 Field Parameters	$20	/each	$320
Supplies		$500	lump sum	$500
Travel		$1,500	lump sum	$1,500
Per Diem	10 days x	$136	day	$1,360
Office ODC		$300	lump sum	$300
Contingency (10%)		$1,308	lump sum	$1,308
			Subtotal	$14,388
			Total for 1 Year of Quarterly Sampling	$57,552
			Total for 1 Year of Semiannual Sampling	$28,776

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Operation and Maintenance of the Biosparging System - 6 trips per year

System Monitoring				
Monitoring Labor	120 hours x	$60	/hour	$7,200
Travel		$1,200	lump sum	$1,200
Per Diem	12 days x	$136	/day	$1,632
Equipment Rental		$1,200	lump sum	$1,200
Electrical Usage				
5 hp x 745.7 watts/hpr=	3729 watts			
746 watts = .746 kilowatts				
3.729 kilowatts x 365 days x 24 hrs/day =		32,666 kw		
32666 kw x $0.06/kw =		$1,960		
				$1,960
			Annual O&M Cost	$13,192
Site Management - per year	100 hrs/yr x	$60	/hour	$6,000

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Inslallation of ORC Barrier plus 1st year of Operation

Cost of 60 4-in ID wells, including mob., drilling, installation, materials/supplies, subcontractor per diem and surface completion (flush mount) (assume $45/linear foot)	$40,500
Well Development (2 hr/well x 60 wells x $100/hr)	$12,000
60 wells x 7 socks per well x 2 sets needed for 1st year of operation x $37.50/sock=	$31,500
Geologist/Inspector (for well installation): 14 days x 10 hr/day x $60/hr	$8,400
Geologist per diem (for well installation): 14 days x $136/day	$1,904
Labor to install ORC socks (2 events)	
2 people x 2 events x 10 hrs/day x 3 days/event x $50/hour	$6,000
Per Diem to install ORC socks (2 events): 12 days x $136/day	$1,632
Travel (2 round trips @ $1500 + 2 round trips @ $300)	$3,600
Equipment Rental (PID) for well installation: 14 days x $65/day	$910
Equipment Rental (PID) for sock installation (2 events): 4 days x $65/day	$260
Misc. Supplies: lump sum	$1,000
Handling/Disposal of Investigation Derived Wastes (soil, water, ORC socks)	
170 drums x $35/drum	$5,950
Stage drums in central location: 25 hours x $100/hour	$2,500
Drum Disposal (170 drums x $65/drum)	$11,050
Disposal-related labor (20 hours x $70/hr)	$1,400
Contingency (10%)	$12,861
subtotal	$141,467

assume 1 set of socks lasts 6 months
assume wells extend 7 feet below water table
assume wells on 5-ft centers
assume 4-inch diameter wells

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual Operational Costs for ORC Barrier (after year 1)

Initial installation of ORC socks plus semiannual replacement for 3 years (total of 6 sock installations). Assume 3 days per installation event for 2 people

60 wells x 7 socks per well x 2 sets needed for 1 year of operation x $37.50/sock	$31,500
Labor per year: 2 people x 3 days x 10 hrs/day x 2 events x $50/hr	$6,000
Per Diem per year: 12 days x $136/day	$1,632
Travel per year: lump sum	$3,000
Equipment Rental (PID) per year: 4 days x $65/day	$260
ORC Filter Sock Disposal: 8 drums/event x $100/drum x 2 events	$1,600
Disposal-related labor (20 hours x $70/hour)	$1,400
Contingency (10%)	$4,539
Total for 1 year (2 installation events)	$49,931

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Summary of Capital Costs Plus First Year of Operational Costs

Biosparging Pilot Test	$26,558
Installation of the 47-Well Biosparging System	$72,917
Installation of ORC barrier + 1st year of operation	$141,467
Groundwater/ Surface water Sampling Quarterly for first year	$57,552
Soil Gas Sampling/ Respiration Testing at 6 Locations for First year	$20,588
Site Managment for first year	$6,000
Annual O&M Cost--Biosparging System	$13,192
Total Capital Costs	$338,273

Remedial Alternative 2 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual Costs

Replace ORC socks semiannually for 3 years

		Annual Cost	$49,931
	P/A i=7%, n=3	PWF = 2.62431604	
		Present Worth Cost	$131,035
Groundwater/ Surface water Sampling Semiannually for 5 years			
		Annual Cost	$28,776
	P/A i=7%, n=5	PWF = 4.10019744	
		Present Worth Cost	$117,987
Biosparging System O&M for 3 years			
		Annual Cost	$13,192
	P/A i=7%, n=3	PWF = 2.62431604	
		Present Worth Cost	$34,620
Soil Gas Sampling Semiannually for three years			
		Annual Cost	$20,588
	P/A i=7%, n=3	PWF = 2.62431604	
		Present Worth Cost	$54,028
Site Management every year for 5 years			
		Annual Cost	$6,000
	P/A i=7% n=5	PWF = 4.10019744	
		Present Worth Cost	$24,601

Future Costs

Present Worth of Confirmatory Soil Sampling		$9,709
	P/F i=7% n=4	
Total Present Worth of Annual Costs =		$362,272
Total Cost Estimate of Proposed Corrective Action =		$710,254

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Capital Costs

Installation of the SVE System

Design/Procure/Install System	130 hours x	$70	/hour	$9,100
ICE Unit (V3)		$65,000	lump sum	$65,000
Asphalt Cutting/ Well Installation		$2,500	lump sum	$2,500
Electrical Subcontractor		$2,500	lump sum	$2,500
Per Diem	20 days x	$136	/day	$2,720
Travel		$1,500	lump sum	$1,500
O & M Manual Preparation	40 hours x	$60	/hour	$2,400
Emissions Permitting		$1,000	lump sum	$1,000
Contingency (10%)		$8,672	lump sum	$8,672
			Subtotal	$95,392

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Installation of Pumping System (3 wells)

Design/perform/analyze 24-hour pumping test (lump sum)					$10,000
Labor--Design, Procure, Construct three 4-inch wells	300	hours x	$70	/hour	$21,000
Drilling Subcontractor	54	feet x	$70	linear foot	$3,780
Drums	10		$35	each	$350
Drum Staging	2	hours x	$100	/hour	$200
Pumps	3		$1,000	each	$3,000
System Controls	1		$4,500	lump sum	$4,500
Per Diem in Field	24	days	$136	/day	$3,264
Travel	1		$1,500	lump sum	$1,500
Equipment Rental (datalogger)	1		$1,300	lump sum	$1,300
Electrical Subcontractor	1		$6,000	lump sum	$6,000
Contingency (10%)	1				$5,489
				Subtotal	$60,383

Design/Construct GW Treatment System

Labor--Design/Procure	250	hours	$70	/hr	$17,500
Labor--Construct	200	hours	$70	/hr	$14,000
Mechanical Subcontractor	1		$12,000	lump sum	$12,000
Prefilter	1		$3,000	lump sum	$3,000
Carbon Cannisters (2)	3600	lb	$2.50	/lb	$9,000
Piping/Valves/supplies	1		$2,500	lump sum	$2,500
Per Diem	30	days	$136	/day	$4,080
Travel	1	round trip	$1,500	/trip	$1,500
Equipment Rental	1		$2,000	lump sum	$2,000
Analytical for Startup					$0
4 BTEX	4		$90	/ea	$360
4 PAH	4		$240	/ea	$960
Prefabricated Building	1		$2,000	lump sum	$2,000
Discharge Permitting				lump sum	$1,000
Contingency (10%)					$6,990
				subtotal	$76,890

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual Operating Costs--GW pump and Treat and SVE Systems (3 years)

Labor	
Weekly System Checks (2 hr x 52 wk/yr x $60/hr)	$6,240
Monthly Sampling (12 hr x 12 mo x $60/hr)	$8,640
Monthly Reporting (8 hr x 12 mo x $60/hr)	$5,760
Maintenance (8 hr x 12 mo x $60/hr)	$5,760
Analytical	
BTEX (4/mo x 12 mo x $90/ea)	$4,320
PAH (1/mo x 12 mo x $240/ea)	$2,880
Supplies	
Carbon Replacement (avg 5800 lb/yr x $2.50/lb)	$14,500
Filters (lump sum)	$1,000
Per Diem (18 days x $136/day)	$2,448
Travel (2 trips from Denver per year @ $1500/ea; 12 trips from Cary @ $100/rip)	$4,200
Supplemental fuel for ICE Unit ($800/mo x 12 mo)	$9,600
Fuel tank rental	$1,000
Site Management	$6,000
Contingency (10%)	$6,635
subtotal	$78,983

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Future Costs

Confirmatory Soil Sampling at 4 Locations

Sampling Labor	80 hours x	$60	/hour	$4,800
8 Soil Samples				
1 QA/QC				
9 Total Samples				
Analytical Subcontractor				
	9 BTEX x	$85	/each	$765
	9 Naphthalene x	$240	/each	$2,160
Geoprobe Rental	2 days x	$500	/day	$1,000
Supplies		$500	lump sum	$500
Travel		$1,500	lump sum	$1,500
Per Diem	4 days x	$136	day	$544
Office ODC		$300	lump sum	$300
Contingency (10%)		$1,157	lump sum	$1,157
		Total Future Cost		$12,726

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual and Operational Costs

Soil Gas Sampling/Respiration Testing at 6 Locations - Semiannually

Soil Gas Analysis (EPA TO-3)	6 samples x	$130	/sample	$780
Sampling Labor	64 hours x	$60	/hour	$3,840
Sample Shipping		$250	lump sum	$250
Per Diem	8 days x	$136	/day	$1,088
Travel		$1,500	lump sum	$1,500
Equipment Rental (Meters)		$500	lump sum	$500
Progress Report	20 hours x	$70	/hour	$1,400
Contingency (10%)		$936	lump sum	$936
			Subtotal	$10,294
	Total for 1 year (two sampling events)			$20,588

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Groundwater and Surface Water Sampling - Quarterly (1 year), Semiannually (4 years)

Sampling Labor	80 hours x	$60	/hour	$4,800
10 Long-Term Monitoring Wells				
4 Surface Water Samples				
2 QA/QC				
16 Total Samples				
Analytical Subcontractor				
	16 BTEX x	$90	/each	$1,440
	10 Naphthalene x	$200	/each	$2,000
	10 Methane	$86	/each	$860
	16 Field Parameters	$20	/each	$320
Supplies		$500	lump sum	$500
Travel		$1,500	lump sum	$1,500
Per Diem	10 days x	$136	day	$1,360
Office ODC		$300	lump sum	$300
Contingency (10%)		$1,308	lump sum	$1,308
			Subtotal	$14,388
			Total for 1 Year of Quarterly Sampling	$57,552
			Total for 1 Year of Semiannual Sampling	$28,776

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Summary of Costs--Capital Costs plus 1st year of O&M

installation of the SVE System		$95,392
Installation of the Pumping System		$60,383
Installation of the GW Treatment System		$76,890
Groundwater/ Surface water Sampling Quarterly for first year		$57,552
Soil Gas Sampling/ Respiration Testing at 6 Locations for First year		$20,588
Site Managment for first year		$6,000
Annual O&M Cost--GW pump and treat and SVE systems		$78,983
	Total	$395,788

Remedial Alternative 3 Cost Estimate
Myrtle Beach AFB - MOGAS Site
725522.04000

Author:
Date:
Checked by:
Date:

Annual Costs

O&M for GW pump and treat and SVE systems (2 years)			
		Annual Cost	$78,983
	P/A i=7%, n=2	PWF = 1.80801817	
		Present Worth Cost	$142,802
Groundwater/ Surface water Sampling Semiannually for 4 years			
		Annual Cost	$28,776
	P/A i=7%, n=4	PWF = 3.38721126	
		Present Worth Cost	$97,470
Soil Gas Sampling Semiannually for two years			
		Annual Cost	$20,588
	P/A i=7%, n=2	PWF = 1.80801817	
		Present Worth Cost	$37,223
Site Management Every Year for 4 Years			
		Annual Cost	$6,000
	P/A i=7% n=4	PWF = 3.38721126	
		Present Worth Cost	$20,323

Future Costs

Present Worth of Confirmatory Soil Sampling			$9,709
	P/F i=7% n=4		
Total Present Worth of Annual Costs =			$297,819

Total Cost Estimate of Proposed Corrective Action = $703,315

APPENDIX J

SITE SAMPLING AND ANALYSIS PLAN

SITE SAMPLING AND ANALYSIS PLAN

FOR

CORRECTIVE ACTION PLAN AND LONG-TERM MONITORING PLAN

RISK-BASED APPROACH TO REMEDIATION

MOGAS SITE, MYRTLE BEACH AFB, SOUTH CAROLINA

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE)
TECHNOLOGY TRANSFER DIVISION

BROOKS AIR FORCE BASE, TEXAS 78235-5000

USAF CONTRACT F41624-93-C-8044

March 1997

Prepared by:

PARSONS ENGINEERING SCIENCE, INC.
1700 Broadway, Suite 900
Denver, Colorado 80290

K:\MYRTLE\TEXT\SQAP.WW6

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (CONTINUED)

Page

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

SECTION 1

INTRODUCTION AND DATA QUALITY OBJECTIVES

1.1 INTRODUCTION

The purpose of this site-specific sampling and analysis plan (SAP) is to describe the procedures to be followed when collecting data in support of source reduction operations, long-term monitoring plan (LTMP), and remediation verification sampling for the risk-based approach to remediation at the MOGAS site at Myrtle Beach Air Force Base (AFB), South Carolina. Details on analytical requirements, desired quantitation (detection) limits, and proposed sampling locations are identified within Section 10 of the Corrective Action Plan (CAP) (Parsons ES, 1996). Specific quality assurance (QA) sampling requirements for the MOGAS site are summarized herein as part of the site-specific sampling procedures. These additional samples will be used to determine the precision, accuracy, completeness, and representativeness of the final data set.

The remainder of Section 1 discusses data quality objectives. Soil gas sampling for bioventing and biosparging is described in Section 2; procedures for soil verification sampling are presented in Section 3; groundwater/ surface water sampling procedures are described in Section 4; and field quality assurance/quality control (QA/QC) samples are described in Section 5. Section 6 describes field data reduction, validation, and reporting; Section 7 presents analytical procedures for groundwater/ surface water and soil verification sampling. References used in this SAP are listed in Section 8.

1.2 DATA QUALITY OBJECTIVES

The objectives of collecting and analyzing environmental samples are 1) to determine the three-dimensional distribution of fuel hydrocarbon contamination at a site; 2) to obtain the data needed to evaluate the effectiveness of specific remedial technologies, including bioventing and intrinsic remediation; 3) to establish site-specific remediation goals that minimize or eliminate risk potential to receptors and limit offsite migration of site-related contamination; and 4) to implement the approved remedial design. This section has been developed for use in conjunction with sampling activities to be undertaken at Myrtle Beach AFB, and describes the QA/QC procedures and protocols that will be used during sample analysis. This section will serve as a controlling mechanism during this investigation to ensure that a sufficient quantity of data is collected and that all data collected are valid, reliable, and defensible.

1.3 ANALYTICAL DATA QUALITY LEVELS

Data quality objectives (DQOs) for the analyses described herein are defined in the interim final guidance, *Data Quality Objectives Process for Superfund* (USEPA, 1993). The analytical levels for this project's DQOs will conform to the two USEPA-defined categories of data. These data categories are defined below (USEPA, 1993):

<u>Screening Data with Definitive Confirmation</u> - Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantification, although the quantification may be relatively imprecise. At least 10 percent of the screening data are confirmed using analytical methods, QA/QC procedures, and QC criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality. Results of field laboratory analyses conducted at the site will be considered screening-category data.

<u>Definitive Data</u> - Definitive data are generated using rigorous analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of hard-copy printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined. Results of fixed-based laboratory analyses of samples collected at the site will be considered definitive data.

During the AFCEE risk-based remediation program, the following data quality levels will be used as indicated:

- Screening analyses with definitive confirmation will be used for the air screening in worker breathing zones for health and safety purposes. This category may also be used to screen samples to select portions for further analysis. For example, soil sample headspace may be screened to determine if laboratory analyses are required. In addition, this data category will be used to determine the presence of geochemical parameters that support intrinsic remediation for fuel contaminants in groundwater. Resulting data will be used to evaluate the effectiveness of intrinsic remediation at the site.

- Definitive analyses will be used to satisfy the requirements for site characterization, risk analysis, decision document preparation, and site cleanup prioritization. USEPA Level III data from previous site investigations will be combined with newly acquired definitive data to evaluate the magnitude and extent of contamination at the site. Definitive data acquired during the investigation will be used to evaluate potential receptor risks and to develop remedial alternatives.

An effective QA program addresses DQOs for both field sampling and laboratory methodologies. The contractor's field QA efforts will focus on assuring that samples are representative of the conditions in the various environmental media at the time of sampling. Fixed-based laboratory QA efforts will be aimed primarily at assuring that analytical procedures provide sufficient accuracy and precision to reliably quantify contaminant levels in environmental samples. The contract laboratory also will ensure that analyzed portions are representative of each sample, and that the results obtained from analysis of each sample are comparable to those obtained from analysis of other similar samples.

1.4 DATA QUALITY ASSESSMENT CRITERIA

Data assessment criteria will be used to evaluate the quality of both the field sampling and screening methods and laboratory performance for the project, and are expressed in terms of analytical precision, accuracy, representativeness, completeness, and comparability. Procedures used to assess data accuracy and precision are in accordance with *Guidelines Establishing Test Procedures for the Analyses of Pollutants,* Appendix III, "Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants" (40 CFR 136), and the respective analytical methods from the USEPA (1995) *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846.*

1.4.1 Precision

Precision is the measure of variability among individual sample measurements under prescribed conditions. The results of laboratory control samples (LCS) demonstrate the precision of the methods. When the LCS results meet the accuracy criteria, (USEPA, 1995) results are believed to be precise. This is based on the LCS being within control limits in comparison to LCS results from previous analytical batches of similar methods and matrices. The relative percent difference (RPD) of field duplicate, laboratory sample duplicate, and matrix spike/matrix spike duplicates (MS/MSD) results demonstrate the precision of the sample matrix. Precision will be expressed in terms of RPD between the values resulting from duplicate analyses. RPD is calculated as follows:

$$RPD = [(x1 - x2)/X][100]$$

where:

x1	=	analyte concentration in the primary sample
x2	=	analyte concentration in the duplicate sample
X	=	average analyte concentration in the primary and the duplicate sample.

Acceptable levels of precision will vary according to the sample matrix, the specific analytical method, and the analytical concentration relative to the method detection limit (MDL). For field duplicate samples, the target RPDs are ≤ 35 percent for soil and

water samples. Precision criteria for the laboratory QC samples are defined by limits listed in Table 1.1. An RPD within the control limit indicates satisfactory precision in a measurement system.

1.4.2 Accuracy

Accuracy is a measure of the closeness of a reported concentration to the true value. Accuracy is expressed as a bias (high or low) and is determined by calculating percent recovery (%R) from MS/MSDs, LCSs, and surrogate spikes. MS/MSD and surrogate spike %Rs indicate accuracy relevant to a unique sample matrix. LCS %Rs indicate accuracy relevant to an analytical batch lot, and are strictly a measure of analytical accuracy conditions independent of samples and matrices. The %R of an analyte, and the resulting degree of accuracy expected for the analysis of QC spiked samples, are dependent upon the sample matrix, method of analysis, and the compound or element being measured. The concentration of the analyte relative to the detection limit of the method also is a major factor in determining the accuracy of the measurement.

Accuracy is expressed as %R and is calculated as follows:

$$\%R = [(A-B)/C] \times 100$$

where:

A = spiked sample concentration

B = measured sample concentration (without spike)

C = concentration of spike added.

Accuracy criteria for the laboratory are defined by control limits listed in Table 1.1.

1.4.3 Completeness

Completeness is defined as the percentage of laboratory measurements judged to be valid on a method-by-method basis. Valid data are defined as all data and/or qualified data considered to meet the DQOs for this project. Data completeness is expressed as percent complete (PC) and should be ≥ 90 percent. The goal for meeting analytical holding times is 100 percent. At the end of each sampling event, the completeness of the data will be assessed. If any data omissions are apparent, the parameter in question will be resampled and/or reanalyzed, if feasible. The laboratory results will be monitored as they become available to assess laboratory performance and its effect on data completeness requirements. When appropriate, additional samples will be collected to ensure that laboratory performance meets PC requirements.

TABLE 1.1
QC[a/] ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b/]	Precision Water (RPD) [c/]	Accuracy Soil (% R)	Precision Soil (RPD)
Aromatic Volatile Organic Compounds	1,2-Dichlorobenzene	61–134	≤ 20	51–144	≤ 30
SW5030A/SW8020A	1,3-Dichlorobenzene	70–131	≤ 20	60–141	≤ 30
(W[d/], S[e/])	1,4-Dichlorobenzene	75–126	≤ 20	66–136	≤ 30
	Benzene	75–125	≤ 20	66–135	≤ 30
	Chlorobenzene	75–129	≤ 20	66–139	≤ 30
	Ethylbenzene	71–129	≤ 20	61–139	≤ 30
	Toluene	70–125	≤ 20	60–135	≤ 30
	Xylenes, total	71–133	≤ 20	61–143	≤ 30
	Surrogates:				
	Bromochlorobenzene	46–136	NA[f/]	36–146	NA
	Bromofluorobenzene	48–138	NA	38–148	NA
	Difluorobenzene	48–138	NA	38–148	NA
	Fluorobenzene	44–165	NA	34–175	NA
	1,1,1-Trifluorotoluene	44–165	NA	34–175	NA
Methane	Methane	70-130	≤ 20	NA	NA
SW3810 Modified	Ethane	70–130	≤ 20	NA	NA
(W)	Ethene	70–130	≤ 20	NA	NA
Volatile Organics	1,1,1,2-Tetrachloroethane	72–125	≤ 20	62–108	≤ 30
SW5030A/SW8260A	1,1,1-Trichloroethane	75–125	≤ 20	65–135	≤ 30
(W, S)	1,1,2,2-Tetrachloroethane	74–125	≤ 20	64–135	≤ 30
	1,1,2-Trichloroethane	75–127	≤ 20	65–135	≤ 30
	1,1-Dichloroethane	72–125	≤ 20	62–135	≤ 30
	1,1-Dichloroethene	75–125	≤ 20	65–135	≤ 30
	1,1-Dichloropropene	75–125	≤ 20	65–135	≤ 30
	1,2,3-Trichlorobenzene	75–137	≤ 20	65–147	≤ 30
	1,2,3-Trichloropropane	75–125	≤ 20	65–135	≤ 30
	1,2,4-Trichlorobenzene	75–135	≤ 20	65–145	≤ 30
	1,2,4-Trimethyl Benzene	75-125	≤ 20	65–135	≤ 30

I:\IN\CHRLSTON\SAPT73.WW6

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b/]	Precision Water (RPD) [c/]	Accuracy Soil (% R)	Precision Soil (RPD)
Volatile Organics (Cont)	1,2-Dichloroethane	68–127	≤ 20	58–137	≤ 30
SW5030A/SW8260A	1,2-Dichlorobenzene	75-125	≤ 20	65–135	≤ 30
(W, S)	1,2-Dibromo-3-chloropropane	59–125	≤ 20	49–135	≤ 30
	1,2-Dichloropropane	70–125	≤ 20	60–135	≤ 30
	1,2-Dibromoethane	75-125	≤ 20	65–135	≤ 30
	1,3,5-Trimethylbenzene	72–112	≤ 20	62–135	≤ 30
	1,3-Dichlorobenzene	75-125	≤ 20	65–135	≤ 30
	1,4-Dichlorobenzene	75-125	≤ 20	65–135	≤ 30
	1-Chlorohexane	75-125	≤ 20	65–135	≤ 30
	2,2-Dichloropropane	75-125	≤ 20	65–135	≤ 30
	2-Chlorotoluene	73–125	≤ 20	63–135	≤ 30
	4-Chlorotoluene	74–125	≤ 20	64–135	≤ 30
	Benzene	75–125	≤ 20	65–135	≤ 30
	Bromobenzene	75–125	≤ 20	65–135	≤ 30
	Bromochloromethane	73–125	≤ 20	63–135	≤ 30
	Bromodichloromethane	75–125	≤ 20	65–135	≤ 30
	Bromoform	75–125	≤ 20	65–135	≤ 30
	Bromomethane	72–125	≤ 20	62–135	≤ 30
	Carbon Tetrachloride	62–125	≤ 20	52–135	≤ 30
	Chlorobenzene	75–125	≤ 20	65–135	≤ 30
	Chlorodibromomethane	75–125	≤ 20	65–135	≤ 30
	Chloroethane	65–125	≤ 20	55–135	≤ 30
	Chloroform	74–125	≤ 20	64–135	≤ 30
	Chloromethane	75-125	≤ 20	65–135	≤ 30
	Cis-1,2-Dichloroethene	75–125	≤ 20	65–135	≤ 30
	Cis-1,3-Dichloropropene	74–125	≤ 20	64–135	≤ 30
	Dibromochloromethane	73–125	≤ 20	63–135	≤ 30
	Dibromomethane	69–127	≤ 20	59–137	≤ 30
	Dichlorodifluoromethane	75-125	≤ 20	65–135	≤ 30
	Dichloropropene	75–125	≤ 20	65–135	≤ 30

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b]	Precision Water (RPD) [c]	Accuracy Soil (% R)	Precision Soil (RPD)
Volatile Organics (Cont)	Ethylbenzene	75–125	≤ 20	65–135	≤ 30
SW5030A/SW8260A	Hexachlorobutadiene	75–125	≤ 20	65–135	≤ 30
(W, S)	Isopropylbenzene	75–125	≤ 20	65–135	≤ 30
	m-Xylene	75–125	≤ 20	65–135	≤ 30
	Methylene Chloride	75–125	≤ 20	65–135	≤ 30
	n-Butylbenzene	75–125	≤ 20	65–135	≤ 30
	n-Propylbenzene	75–125	≤ 20	65–135	≤ 30
	Naphthalene	75–125	≤ 20	65–135	≤ 30
	o-Xylene	75–125	≤ 20	65–135	≤ 30
	p-Isopropyltoluene	75–125	≤ 20	65–135	≤ 30
	p-Xylene	75–125	≤ 20	65–135	≤ 30
	Sec-Butylbenzene	75–125	≤ 20	65–135	≤ 30
	Styrene	75–125	≤ 20	65–135	≤ 30
	Trichloroethene	71–125	≤ 20	61–135	≤ 30
	Tetrachloroethylene	71–125	≤ 20	61–135	≤ 30
	Toluene	74–125	≤ 20	64–135	≤ 30
	Trans-1,2-Dichloroethene	75–125	≤ 20	65–135	≤ 30
	Trans-1,3-Dichloropropene	66–125	≤ 20	56–135	≤ 30
	Trichlorofluoromethane	67–125	≤ 20	57–135	≤ 30
	Vinyl Chloride	46–134	≤ 20	36–144	≤ 30
	Xylenes, Total	75–125	≤ 20	65–135	≤ 30
	Surrogates:				
	Dibromofluoromethane	75–125	NA	65–135	NA
	Toluene-D8	75–125	NA	65–135	NA
	4-Bromofluorobenzene	75–125	NA	65–135	NA
	1,2-Dichloroethane-D4	62–139	NA	52–149	NA
Semivolatile Organics Base/Neutral Extractables	1,2,4-Trichlorobenzene	44–142	≤ 20	34–152	≤ 30
	1,2-Dichlorobenzene	42–155	≤ 20	32–135	≤ 30
SW3510B/SW8270B (W)	1,3-Dichlorobenzene	36–125	≤ 20	26–135	≤ 30
SW3550A/SW8270B (S)	1,4-Dichlorobenzene	30–125	≤ 20	25–135	≤ 30

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) b/	Precision Water (RPD) c/	Accuracy Soil (% R)	Precision Soil (RPD)
Semivolatile Organics Base/Neutral Extractables	2,4-Dinitrotoluene	39–139	≤ 20	29–149	≤ 30
	2,6-Dinitrotoluene	51–125	≤ 20	41–135	≤ 30
SW3510B/SW8270B (W)	2-Chloronaphthalene	60–125	≤ 20	50–135	≤ 30
SW3550A/SW8270B (S)	2-Methylnaphthalene	41–125	≤ 20	31–135	≤ 30
(Cont)	2-Nitroaniline	50–125	≤ 20	40–135	≤ 30
	3,3'-Dichlorobenzidine	29–175	≤ 20	25–175	≤ 30
	3-Methylphenol	41–144	≤ 20	31–154	≤ 30
	3-Nitroaniline	51–125	≤ 20	41–135	≤ 30
	4-Bromophenyl Phenyl Ether	53–127	≤ 20	43–137	≤ 30
	4-Chloroaniline	45-136	≤ 20	35-146	≤ 30
	4-Chlorophenyl Phenyl Ether	51–132	≤ 20	41–142	≤ 30
	4-Nitroaniline	40–143	≤ 20	30–153	≤ 30
	Acenaphthalene	47–125	≤ 20	37–135	≤ 30
	Acenaphthene	49–125	≤ 20	39–135	≤ 30
	Anthracene	45–165	≤ 20	35–175	≤ 30
	Benz (a) Anthracene	51–133	≤ 20	41–143	≤ 30
	Benzo (a) Pyrene	41–125	≤ 20	31–135	≤ 30
	Benzo (b) Fluoranthene	37–125	≤ 20	27–1 35	≤ 30
	Benzo (g,h,i) Perylene	34–149	≤ 20	25–159	≤ 30
	Benzo (k) Fluoranthene	37–125	≤ 20	27–135	≤ 30
	Benzyl Alcohol	35–125	≤ 20	25–135	≤ 30
	Bis (2-chloroethoxy) Methane	49–125	≤ 20	39–135	≤ 30
	Bis (2-chloroethyl) Ether	44–125	≤ 20	34–135	≤ 30
	Bis (2-chloroisopropyl) Ether	36–166	≤ 20	26–175	≤ 30
	Bis (2-ethylhexyl) Phthalate	33–129	≤ 20	25–139	≤ 30
	Butyl Benzyl Phthalate	26–125	≤ 20	25–135	≤ 30
	Carbazole	34–132	≤ 20	25–142	≤ 30
	Chrysene	55–133	≤ 20	45–143	≤ 30
	Di-n-Butyl Phthalate	34–126	≤ 20	25–136	≤ 30
	Di-n-Octyl Phthalate	38–127	≤ 20	28–137	≤ 30
	Dibenzo (a,h) Anthracene	50–125	≤ 20	40–135	≤ 30

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b/]	Precision Water (RPD) [c/]	Accuracy Soil (% R)	Precision Soil (RPD)
Semivolatile Organics Base/Neutral Extractables	Dibenzofuran	52–125	≤ 20	42–135	≤ 30
	Diethyl Phthalate	37–125	≤ 20	27–135	≤ 30
SW3510B/SW8270B (W)	Dimethyl Phthalate	25–175	≤ 20	25–175	≤ 30
SW3550A/SW8270B (S)	Fluoranthene	47–125	≤ 20	37–135	≤ 30
(Cont)	Fluorene	48–139	≤ 20	38–149	≤ 30
	Hexachlorobenzene	46–133	≤ 20	36–143	≤ 30
	Hexachlorobutadiene	25–125	≤ 20	25–135	≤ 30
	Hexachlorocyclopentadiene	41–125	≤ 20	31–135	≤ 30
	Hexachloroethane	25–153	≤ 20	25–163	≤ 30
	Indeno (1,2,3-c,d) Pyrene	27–160	≤ 20	25–170	≤ 30
	Isophorone	26–175	≤ 20	25–175	≤ 30
	N-Nitrosodi-n-propylamine	37–125	≤ 20	27–135	≤ 30
	N-Nitrosodiphenylamine	27–125	≤ 20	25–135	≤ 30
	Naphthalene	50–125	≤ 20	40–135	≤ 30
	Nitrobenzene	46–133	≤ 20	36–143	≤ 30
	p-Chloroaniline	56–125	≤ 20	46–135	≤ 30
	Phenanthrene	54–125	≤ 20	44–135	≤ 30
	Pyrene	47–136	≤ 20	37–146	≤ 30
Semivolatile Organics	2,4,5-Trichlorophenol	25–175	≤ 20	25–175	≤ 30
Acid Extractables	2,4,6-Trichlorophenol	39–128	≤ 20	29–138	≤ 30
SW3510B/SW8270B (W)	2,4-Dichlorophenol	46–125	≤ 20	36–135	≤ 30
SW3550A/SW8270B (S)	2,4-Dimethylphenol	45–139	≤ 20	35–149	≤ 30
	2,4-Dinitrophenol	30–151	≤ 20	25–161	≤ 30
	2-Chlorophenol	41–125	≤ 20	31–135	≤ 30
	2-Methylphenol	25–125	≤ 20	25–135	≤ 30
	2-Nitrophenol	44–125	≤ 20	34–135	≤ 30
	4,6-Dinitro-2-Methyl Phenol	26–134	≤ 20	25–144	≤ 30
	4-Chloro-3-Methyl Phenol	44–125	≤ 20	34–135	≤ 30
	4-Methylphenol	33–125	≤ 20	25–135	≤ 30
	4-Nitrophenol	25–131	≤ 20	25–141	≤ 30

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b/]	Precision Water (RPD) [c/]	Accuracy Soil (% R)	Precision Soil (RPD)
	Benzoic Acid	25–162	≤ 20	25–172	≤ 30
Semivolatile Organics	Pentachlorophenol	28–136	≤ 20	38–146	≤ 30
Acid Extractables	Phenol	25–125	≤ 20	25–135	≤ 30
SW3510B/SW8270B (W)	*Surrogates:*				
SW3550A/SW8270B (S)	2,4,6-Tribromophenol	25–134	NA	25–144	NA
(Cont)	2-Fluorobiphenyl	43–125	NA	34–135	NA
	2-Fluorophenol	25–125	NA	25–135	NA
	Nitrobenzene-D5	32–1[illegible]5	NA	25–135	NA
	Phenol-D5	25–125	NA	25–135	NA
	Terphenyl-D14	42–126	NA	32–136	NA
Polynuclear Aromatic	1-Methylnaphthalene	25–150	≤ 30	25–160	≤ 50
Hydrocarbons	2-Methylnaphthalene	25–150	≤ 30	25–160	≤ 50
SW3510B/SW8310 (W)	Acenaphthalene	49–125	≤ 30	39–135	≤ 50
SW2550A/SW8310 (S)	Acenaphthene	43–130	≤ 30	33–140	≤ 50
	Anthracene	54–125	≤ 30	44–135	≤ 50
	Benzo (a) Anthracene	39–135	≤ 30	29–145	≤ 50
	Benzo (a) Pyrene	52–125	≤ 30	42–135	≤ 50
	Benzo (b) Fluoranthene	31–137	≤ 30	25–147	≤ 50
	Benzo (g,h,i) Perylene	53–125	≤ 30	43–135	≤ 50
	Benzo (k) Fluoranthene	60–129	≤ 30	50–139	≤ 50
	Chrysene	59–134	≤ 30	49–144	≤ 50
	Dibenzo (a,h) Anthracene	51–125	≤ 30	41–135	≤ 50
	Fluoranthene	42–125	≤ 30	32–135	≤ 50
	Fluorene	53–125	≤ 30	43–135	≤ 50
	Indeno (1,2,3-c,d) Pyrene	55–125	≤ 30	45–135	≤ 50
	Naphthalene	43–125	≤ 30	33–135	≤ 50
	Phenanthrene	52–129	≤ 30	42–139	≤ 50
	Pyrene	55–125	≤ 30	45–135	≤ 50
	Surrogates:				
	Terphenyl-D14	25–157	NA	22–167	NA

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b/]	Precision Water (RPD) [c/]	Accuracy Soil (% R)	Precision Soil (RPD)
ICP Screen for Metals	Aluminum	80–120	≤ 15	80–120	≤ 25
SW3005A/SW6010A (W)	Antimony	80–120	≤ 15	80–120	≤ 25
SW3050A/SW6010A (S)	Arsenic	80–120	≤ 15	80–120	≤ 25
	Barium	80–120	≤ 15	80–120	≤ 25
	Beryllium	80–120	≤ 15	80–120	≤ 25
	Cadmium	80–120	≤ 15	80–120	≤ 25
	Calcium	80–120	≤ 15	80–120	≤ 25
	Chromium	80–120	≤ 15	80–120	≤ 25
	Cobalt	80–120	≤ 15	80–120	≤ 25
	Copper	80–120	≤ 15	80–120	≤ 25
	Iron	80–120	≤ 15	80–120	≤ 25
	Lead	80–120	≤ 15	80–120	≤ 25
	Magnesium	80–120	≤ 15	80–120	≤ 25
	Manganese	80–120	≤ 15	80–120	≤ 25
	Molybdenum	80–120	≤ 15	80–120	≤ 25
	Nickel	80–120	≤ 15	80–120	≤ 25
	Potassium	80–120	≤ 15	80–120	≤ 25
	Selenium	80–120	≤ 15	80–120	≤ 25
	Silver	80–120	≤ 15	80–120	≤ 25
	Sodium	80–120	≤ 15	80–120	≤ 25
	Thallium	80–120	≤ 15	80–120	≤ 25
	Vanadium	80–120	≤ 15	80–120	≤ 25
	Zinc	80–120	≤ 15	80–120	≤ 25
SW3020A/SW7421 (W) SW3050A/SW7421 (S)	Lead	74-124	≤ 15	74-124	≤ 25
Common Anions	Bromide	86–112	≤ 20	86–112	≤ 30
SW9060	Chloride	91–111	≤ 20	91–111	≤ 30
	Fluoride	86–114	≤ 20	86–114	≤ 30
	Nitrate	90–110	≤ 20	90–110	≤ 30
	Nitrite	88–116	≤ 20	88–116	≤ 30
	Phosphate	87–110	≤ 20	87–110	≤ 30

TABLE 1.1 (Continued)
QC ACCEPTANCE CRITERIA
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Accuracy Water (% R) [b/]	Precision Water (RPD) [c/]	Accuracy Soil (% R)	Precision Soil (RPD)
SW9060 (cont)	Sulfate	88–115	≤ 20	88–115	≤ 30
E160.1	Total Dissolved Solids	NA	≤ 20	NA	NA
E160.2	Total Suspended Solids	NA	≤ 20	NA	NA
E310.1	Alkalinity	80-120	≤ 20	80-120	NA
E353.1	Nitrogen, nitrate/nitrite	80-120	≤ 20	80-120	NA
SW9050	Conductance	NA	≤ 20	NA	NA
SW9040	pH	NA	NA	NA	NA

SOURCE: AFCEE QAPP, Version 1.1, February 1996

[a/] QC = Quality Control
[b/] %R = Percent Recovery
[c/] RPD = Relative percent difference
[d/] W = Water
[e/] S = Soil
[f/] NA = Not applicable

PC is calculated as follows:

$$PC = \frac{N_A}{N_I} X100$$

Where:

N_A = Actual number of valid analytical results obtained

N_I = Theoretical number of results obtainable under ideal conditions.

1.4.4 Comparability

Comparability expresses the confidence with which data from one sample, sampling round, site, laboratory, or project can be compared to those from another. Comparability during sampling is dependent upon sampling program design and time periods. Comparability during analysis is dependent upon analytical methods, detection limits, laboratories, units of measure, and sample preparation procedures.

Comparability is determined on a qualitative rather than quantitative basis. For this project, comparability of all data collected will be ensured by adherence to standard sample collection procedures, standard field measurement procedures, and standard reporting methods, including consistent units. For example, concentrations will be reported in a manner consistent with general industry practice (e.g., soil data will be reported on a dry-weight basis).

In addition, to support the comparability of fixed-base laboratory analytical results with those obtained in previous or future testing, all samples will be analyzed by USEPA-approved methods, where available. The USEPA-recommended maximum permissible holding times for organic and inorganic parameters will not be exceeded. All analytical standards will be traceable to standard reference materials. Instrument calibrations will be performed in accordance with USEPA method specifications, and will be checked at the frequency specified for the methods. The results of these analyses can then be compared with analyses by other laboratories and/or with analyses for other sites addressed by this site investigation.

1.4.5 Representativeness

Representativeness expresses the extent to which collected data define site contamination. Where appropriate, sample results will be statistically characterized to determine the degree to which the data accurately and precisely represent a characteristic of a population, parameter variation at a sampling point, a process, or an environmental condition.

Sample collection, handling, and analytical procedures will strive to obtain the most representative sample possible. Representative samples will be achieved by the following:

- Collection of samples from locations fully representing site conditions;
- Use of appropriate sampling procedures, including equipment and equipment decontamination;
- Use of appropriate analytical methods for the required parameters and project reporting limits; and
- Analysis of samples within the required holding times.

Sample representativeness also is affected by the portion of each collected sample that is chosen for analysis. The laboratory will adequately homogenize all samples prior to taking aliquots for analysis to ensure that the reported results are representative of the sample received. Because many homogenization techniques may cause loss of contaminants through volatilization, homogenization for all volatile organic compound (VOC) method analyses will be performed with extreme care to minimize these risks.

SECTION 2

SOIL GAS SAMPLING

2.1 INTRODUCTION

Soil gas will be used as an indicator of subsurface hydrocarbon contamination and to assess the effectiveness of *in situ* bioventing and biosparging operations in removing source contamination at the site. The use of soil gas to delineate potential subsurface contamination and to determine effectiveness of source reduction technologies has several economic and technical advantages over more traditional drilling and soil sampling techniques. The labor and equipment cost can be significantly less than a conventional drilling and sampling team. Many new hydraulically driven, multi-purpose probes can be used for soil gas sampling. These probes can be advanced as quickly as conventional augers and do not produce drill cuttings which can require expensive analysis and disposal. Further, soil gas sampling can represent the average chemistry of several cubic feet of soil as compared to a discrete soil sample, which can only describe a few cubic inches of the subsurface. This is of particular importance in risk-based remediation projects where the extent of contamination and the degree of contaminant removal can most accurately be determined by using multiple soil gas sampling locations.

2.2 SOIL GAS SAMPLING FREQUENCY AND LOCATIONS

The test equipment and methods that will be required to conduct field soil gas sampling as part of the risk-based remediation at this site are described fully in *Addendum One to Test Plan and Technical Protocol for a Field Treatability Test for Bioventing - Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential* (Downey and Hall, 1994). In summary, soil gas sampling will be conducted initially to establish a soil gas chemistry baseline prior to implementation of full-scale bioventing and biosparging at the site. Field screening analytical samples will be collected biannually during bioventing and biosparging operations to assess contaminant removal rates, radius of influence, and oxygenation of contaminated saturated and unsaturated soils. Bioventing/ biosparging operations are expected to decrease contaminant mass in soil underlying the MOGAS site to maintain COPCs concentrations at levels below soil leaching SSTLs.

Soil gas sampling will be performed every 6 months during bioventing/biosparging operations to measure contaminant reduction, oxygen utilization, biodegradation rates. Once soil gas contaminant concentrations and respiration rates indicate contaminant mass loss via biodegradation, confirmatory soil samples will be collected to verify that bioventing operations have maintained soil contaminant concentrations below the most

stringent Tier 2 site-specific target levels (SSTLs). This is anticipated to take approximately 3 years. Results of soil gas sampling for both bioventing and biosparging operations will be provided to Myrtle Beach AFB, the US Air Force Center for Environmental Excellence (AFCEE), and the South Carolina Department of Health and Environmental Control (SCDHEC) to update all parties involved in the remediation process.

2.3 SOIL GAS SAMPLING PROCEDURES

Soil gas sampling will be conducted at eight existing and several newly installed MPs (and groundwater monitoring, air sparging, and vent wells with unsaturated screen when possible). Gaseous concentrations of carbon dioxide (CO_2) and oxygen (O_2) will be measured in the field using an O_2/CO_2 analyzer. The analyzer will generally have an internal battery-powered sampling pump and range settings of 0 to 25 percent for both O_2 and CO_2. Before analyzing samples, the analyzer must be calibrated and the battery charge checked. The analyzer will be calibrated daily using atmospheric conditions of O_2 (20.9 percent) and CO_2 (0.05 percent) and a gas standard containing 0.0 percent O_2 and 5.0 percent CO_2.

Total volatile hydrocarbon (TVH) concentrations also will be measured at the MOGAS site. The TVH analyzer used at the site will be capable of measuring hydrocarbon concentrations in the range of 1 to 20,000 parts per million, volume per volume (ppmv). The analyzer is also capable of distinguishing between methane and non-methane hydrocarbons. The TVH analyzer will be calibrated daily using a 4,000 ppmv hexane calibration gas.

All soil gas samples taken during monitoring at the site will be collected using 3-liter Tedlar® bags and a vacuum chamber. The soil gas samples will be analyzed by attaching the O_2/CO_2 and TVH analyzers directly to the Tedlar® bag. Sample locations identified for analytical, compound-specific analysis will be re-sampled using 3-liter Tedlar® bags and a vacuum chamber. The samples will then be transferred to 1-liter SUMMA® canisters and shipped to Air Toxics, Inc. in Folsom, California for compound-specific analysis using US Environmental Protection Agency (USEPA) analytical Method TO-3 (refer to Table 2.1 in the CAP).

Field quality assurance/quality control (QA/QC) procedures for soil gas will include collection of one field duplicate for every 10 samples collected (e.g., frequency of 10 percent), use of analyte-appropriate containers, and chain-of-custody procedures for sample handling and tracking. All samples to be transferred to the analytical laboratory for analysis will be clearly labeled to indicate sample number, location, matrix (e.g., soil gas), and analyses requested. Samples will be preserved in accordance with the analytical method to be used.

All field sampling activities will be recorded in a bound, sequentially paginated field notebook in permanent ink. All sample collection entries will include the date, time, sample locations and numbers, notations of field observations, and the sampler's name and signature.

The analytical laboratory will conduct one matrix spike analysis, one laboratory control sample, and one laboratory blank test for each specific analysis requested for soil gas (i.e., required only once for soil gas since only one analytical method will be used).

SECTION 3

COMPLIANCE SOIL SAMPLING

3.1 INTRODUCTION

Compliance soil sampling will be performed as part of the LTMP to ensure that bioventing/ biosparging has reduced soil contaminant mass and maintained concentrations below soil SSTLs protective of the underlying groundwater. A total of nine soil samples will be collected at the MOGAS site as part of the compliance sampling program. Eight samples will be collected from four boreholes within the bioventing/ biosparging treatment area and one QA/QC sample will be collected. The following sections describe the soil sampling locations, borehole installation, soil sampling, procedures for equipment decontamination, and datum surveying procedures to be used as part of the soil sampling field effort

3.2 SAMPLING LOCATIONS

A total of four sampling locations will be used during the compliance sampling event at the MOGAS site. One borehole will be placed adjacent to each of the existing vertical vent wells, and one borehole will be placed approximately 50 feet downgradient of each vent well. The exact locations of the boreholes will be determined in the field based on the location of underground utilities and other potential interferences. Two samples will be collected from each borehole, one above the groundwater level and one below, for a total of eight samples. One QA/QC field replicate also will be collected from one of the boreholes.

3.3 BOREHOLE INSTALLATION PROCEDURES

Soil sampling in unconsolidated soils will be accomplished using a Geoprobe® hydraulic sampling rig. The Geoprobe® will be used to advance a 2-inch-diameter sampler containing a butylene liner to the desired sampling depth. Once the desired sampling depth is attained, the end point of the sampler will be removed and the sampler will be filled with soil. The sampler will be returned to the surface, the liner removed, and its ends capped with Teflon® squares and plastic caps. All sampling equipment will be decontaminated prior to use and between uses, as described in Section 3.8. If subsurface conditions are such that the planned installation technique does not produce acceptable results another technique deemed more appropriate to the type of soils present will be used. Any alternate soil sampling procedure used must be approved by the Parsons Engineering Science, Inc. (Parsons ES) field hydrogeologist and will be appropriate for the subsurface lithologies present at the site.

The Parsons ES field hydrogeologist will be responsible for observing all borehole installation and sampling activities, maintaining a detailed log of the target sample interval, photographing representative samples, and properly labeling and storing samples. An example of the proposed geologic boring log form is presented in Figure 3.1. The descriptive log will contain:

- Sample interval (top and bottom depth);
- Sample recovery;
- Presence or absence of contamination (e.g., staining, odor or elevated headspace screening readings);
- Soil or rock description of the target sampling interval, including relative density, color, major textural constituents, minor constituents, porosity, relative moisture content, plasticity of fines, cohesiveness, grain size, structure or stratification, relative permeability, and any other significant observations; and
- The depth of lithologic contacts and/or significant textural changes, measured and recorded to the nearest 0.1 foot (1 inch) if present within the target interval.

3.4 SAMPLE HANDLING

This section describes the handling of soil samples from the time of sampling until the samples arrive at the laboratory.

3.4.1 Sample Containers and Labels

New, factory cleaned butylene sample sleeves and end caps will be provided by Parsons ES field personnel. The sample label will be firmly attached to the sample sleeve immediately after sample collection, and the following information will be legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample depth;
- Sampling date;
- Sampling time; and
- Sample collector's initials.

3.4.2 Sample Preservation

Samples will be properly prepared for transportation to the laboratory by placing the samples in an adequately padded cooler containing ice to maintain an approximate shipping temperature of 4 degrees centigrade (°C).

GEOLOGIC BORING LOG

BORING NO. ______________________ CONTRACTOR: ______________________ DATE SPUD: ______________________

CLIENT: ______________________ RIG TYPE: ______________________ DATE CMPL: ______________________

JOB NO.: ______________________ DRLG METHOD: ______________________ ELEVATION: ______________________

LOCATION: ______________________ BORING DIA.: ______________________ TEMP.: ______________________

GEOLOGIST: ______________________ DRLG FLUID ______________________ WEATHER: ______________________

COMMENTS: ____

Elev. (ft.)	Depth (ft.)	Pro-file	US CS	Geologic Description	Samples No.	Samples Depth (ft)	Sample Type	Penet. Res.	Remarks TIP = Bkgrnd/Reading (ppm)
	1								
	5								
	10								
	15								
	20								
	25								
	30								

sl – slight	v – very	f – fine
tr – trace	lt – light	m – medium
sm – some	dk – dark	c – coarse
& – and	bf – buff	BH – Bore Hole
@ – at	brn – brown	SAA – Same As Above
w – with	blk – black	

SAMPLE TYPE

D – DRIVE

C – CORE

G – GRAB

C Core recovery

Core lost

Water level drilled

Figure 3-1

3.4.3 Sample Shipment

After the samples are sealed and labeled, they will be packaged for transport to Evergreen Analytical, Inc. of Wheat Ridge, Colorado, the AFCEE-approved laboratory for this demonstration. Samples will be shipped priority overnight via Federal Express®. The following packaging and labeling procedures will be followed:

- Package sample so that it will not leak, spill, or vaporize from its container;
- Label shipping container with:
  - Sample collector's name, address, and telephone number;
  - Laboratory's name, address, and telephone number;
  - Description of sample;
  - Quantity of sample; and
  - Date of shipment.

The packaged samples will be delivered to the laboratory as soon as possible after sample acquisition, and in accordance with analytical method-specific holding times.

3.4.4 Chain-of-Custody Control

After the samples have been collected, chain-of-custody procedures will be followed to establish a written record of sample handling and movement between the sampling site and the laboratory. Each shipping container will have a chain-of-custody form completed in triplicate by the sampling personnel. One copy of this form will be kept by the sampling team and the other two copies will be sent to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analytical results. The chain-of-custody will contain the following information:

- Sample identification number;
- Sample collector's printed name and signature;
- Date and time of collection;
- Place and address of collection;
- Sample matrix;
- Analyses requested;
- Signatures of individuals involved in the chain of possession; and
- Inclusive dates of possession.

The chain-of-custody documentation will be placed inside the shipping container so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during transport. The shipping container will be sealed so that it will be obvious if the seal has been tampered with or broken.

3.4.5 Sampling Records

In order to provide complete documentation of the sampling event, detailed records will be maintained by the Parsons ES field hydrogeologist. At a minimum, these records will include the following information:

- Sample location (facility name);
- Sample identification;
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observations of
  - Sample appearance,
  - Sample odor;
- Weather conditions;
- Sampler's identification;
- Any other relevant information.

3.5 LABORATORY ANALYSES

Laboratory analyses will be performed on all soil samples and the required QA/QC samples (see Section 3.6 and Section 5). The analytical methods and detection limit requirements for soil compliance samples are discussed in Section 10 of the CAP. Samples will by analyzed by USEPA analytical method 8020 for benzene, toluene, ethylbenzene, and total xylenes (BTEX) and by USEPA analytical method 8270 for naphthalene. Evergreen Analytical Laboratories of Wheat Ridge, Colorado, will be performing the laboratory analyses. All containers, preservatives, and shipping requirements will be consistent with laboratory protocol. Laboratory personnel will specify any additional QC samples required. Shipping containers, ice chests with adequate padding, and cooling media will be sent by the laboratory to the site.

3.6 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

As a check on the quality of field sampling activities (sampling, containerization, shipment, and handling) QA/QC trip blanks, field blanks, equipment rinseate samples,

and field replicates will be sent to the laboratory. QA/QC sampling will include one replicate for soil samples (i.e., frequency of 10 percent), one rinseate sample (i.e., frequency of 10 percent), one field blank, and a trip blank for each individual shipping cooler sent to the analytical laboratory containing samples for volatile organic compound (VOC) analysis. The procedures for the collection of field QA/QC samples are discussed in Section 5 of this SAP. Laboratory QA/QC procedures will include one matrix spike analysis, one laboratory control sample, and one laboratory blank sample test for each specific analysis requested.

3.7 MINIMIZATION AND MANAGEMENT OF SOIL RESIDUALS

Borehole installation and soil sampling activities using the Geoprobe® will generate no soil cuttings that will require proper handling and, if contaminated, proper disposal.

3.8 EQUIPMENT DECONTAMINATION PROCEDURES

Water to be used in equipment cleaning will be obtained from one of the Base's onsite water supplies. Myrtle Beach AFB personnel will assist Parsons ES field personnel in locating a suitable source. Water use approval will be verified by contacting the appropriate facility personnel. Only potable water will be used for decontamination. A decontamination water blank will be collected from the potable water source. The procedures for the collection of the decontamination water blank are described in Section 5. The Parsons ES field hydrogeologist will make the final determination as to the suitability of site water for these activities.

Prior to arriving at the site, and between each borehole installation, the Geoprobe® rods, samplers, tools and other downhole equipment will be decontaminated using a hot-water wash. During borehole installation operations, the rig, samplers, and any other downhole equipment will be decontaminated at a temporary decontamination pad that will be set up adjacent to each borehole location. The decontamination fluids will be stored in 55-gallon Department of Transportation (DOT) approved drums for proper treatment and disposal.

All sampling tools will be cleaned with a clean water/phosphate-free detergent mix, a clean water rinse, isopropyl alcohol rinse, and a final distilled water rinse. Materials that cannot be cleaned to the satisfaction of the Parsons ES field hydrogeologist will not be used. All decontamination activities will be conducted in a manner so that the excess water will be controlled and not allowed to flow into any open borehole.

Fuel, lubricants, and other similar substances will be handled in a manner consistent with accepted safety procedures and standard operating practices. The Geoprobe® rig will not be allowed onsite unless it is free from leaks in all hydraulic and fuel lines, and is free of any exterior oil and grease.

Surface runoff such as miscellaneous spills and leaks, precipitation, and spilled decontamination fluids will not be allowed to enter any boring. Berms around the borehole and surficial bentonite packs, as appropriate, will be used to prevent cross-contamination.

3.9 SURVEY OF BOREHOLE LOCATIONS

The horizontal location of the new boreholes will be located by Parsons ES field personnel after completion of sampling procedures. Horizontal locations will be measured relative to previously installed groundwater wells that have established coordinates (i.e., previously surveyed by a register surveyor). Horizontal distances will be recorded to the nearest 0.1 foot by measuring the distance from each borehole to three established locations (monitoring wells or other previously surveyed locations deemed more appropriate by field personnel). These distances will be used to locate each borehole on any additional maps generated as part of the risk-based investigation.

3.10 BOREHOLE ABANDONMENT

Geoprobe® sampling operations will produce boreholes that are approximately 2.5 inches in diameter. These holes will be abandoned by filling with pelletized bentonite. The bentonite will be hydrated in place with potable water at 2-foot intervals to ensure proper hydration and subsequent sealing of the borehole. The concrete at the site will be patched with ready-mix concrete troweled to match the existing grade.

SECTION 4

GROUNDWATER AND SURFACE WATER SAMPLING

4.1 INTRODUCTION

This section describes the scope of work required for collecting groundwater and surface water samples from the 10 monitoring wells in the long-term monitoring well network and four permanent surface water sampling stations. All water samples collected from groundwater monitoring wells will be obtained using a thoroughly decontaminated peristaltic pump and new flexible tubing. Equipment blanks will be collected to assure that all equipment is properly cleaned. In order to maintain a high degree of QC during this sampling event, the procedures described in the following sections will be followed.

Groundwater/ surface water sampling will be conducted by qualified Parsons ES scientists and technicians trained in the conduct of well sampling, records documentation, and chain-of-custody procedures. In addition, sampling personnel will have thoroughly reviewed the work plan and this site-specific sampling and analysis plan prior to sample acquisition and will have a copy of both available onsite for reference.

Activities that will occur during groundwater/ surface water sampling are summarized below:

- Assembly and preparation of equipment and supplies;
- Inspection of the well integrity, including:
  - Protective cover, cap and lock,
  - External surface seal and pad,
  - Well stick-up, cap, and datum reference,
  - Internal surface seal,
  - Condition of any dedicated equipment, if present;
- Groundwater sampling, including:
  - Water level measurements,

- Visual inspection of borehole water,
- Well purging,
- Sampling;

- Surface water sampling, including:
    - Inspection of permanent location marker (i.e., visibility, integrity),
    - Visual inspection of surface water,
    - Sampling;
- Sample preservation and shipment, including:
    - Sample preparation and preservation, as appropriate,
    - Onsite measurement of physical parameters,
    - Sample labeling,
    - Sample packaging in appropriate shipping containers;
- Completion of sampling records;
- Completion of chain-of-custody records; and
- Sample shipment via overnight courier.

Detailed groundwater/ surface water sampling and sample handling procedures are presented in following sections.

4.2 GROUNDWATER/ SURFACE WATER SAMPLING LOCATIONS

Groundwater samples will be collected from the 10 wells shown in Figure 10.1 of the CAP, using a thoroughly decontaminated peristaltic pump with new, dedicated flexible tubing. The four surface water sampling stations in the ditch south of the MOGAS site also are shown in Figure 10.1 of the CAP.

4.3 PREPARATION FOR SAMPLING

All equipment to be used for sampling will be assembled and properly cleaned and calibrated (if required) prior to the beginning of the sampling event. In addition, all record keeping materials will be gathered prior to leaving the office. A brief organizational meeting will be held to ensure proper communication between project management staff and field personnel.

4.4 EQUIPMENT DECONTAMINATION

All portions of sampling and test equipment that will contact the sample will be thoroughly cleaned before each use. This equipment may include water-level probe and cable, oil/water interface probe and cable, test equipment for onsite use, and other equipment or portions thereof that will contact the samples. Based on the chemical constituents present at the MOGAS site, the following decontamination protocol will be used:

- Clean with potable water and phosphate-free laboratory detergent (Liquinox® or equivalent);
- Rinse with potable water;
- Rinse with distilled or deionized water;
- Rinse with reagent-grade isopropanol;
- Rinse with distilled or deionized water; and
- Air dry the equipment prior to use.

All decontamination fluids will be temporarily placed in 55-gallon DOT approved containers for proper disposal.

Any deviations from these procedures will be documented in the field scientist's field notebook and on the groundwater sampling form. If pre-cleaned dedicated sampling equipment is used, the decontamination protocol specified above will not be required. Laboratory-supplied sample containers will be cleaned and sealed by the laboratory and therefore will not need to be cleaned in the field. Equipment field blanks and equipment rinseate samples will be collected to assure that all containers and field equipment are free of contamination.

4.5 EQUIPMENT CALIBRATION

As required, field analytical equipment will be calibrated according to the manufacturer's specifications prior to field use. This applies to equipment used for onsite chemical measurements such as pH, electrical conductivity, and temperature. Additional details on the calibration of field equipment are presented in Section 6 of this SAP.

4.6 SAMPLING PROCEDURES

Special care will be taken to prevent contamination of the groundwater/ surface water and extracted samples. The two primary ways in which sample contamination can occur are through contact with improperly cleaned equipment and by cross-contamination through insufficient decontamination of equipment between wells. To prevent such contamination, the peristaltic pump and water level probe and cable used to determine static water levels and total well depth will be thoroughly cleaned before

and after field use and between uses at different sampling locations according to the procedures presented in Section 4.4. In addition to the use of properly cleaned equipment, a clean pair of new, disposable nitrile gloves will be worn each time a different well or station is sampled. New, clean tubing will be used for the peristaltic pump for each well sampled. Wells will be sampled sequentially from areas suspected to be least contaminated to areas suspected to be more contaminated. Plastic will be placed around each of the wells to be sampled and sampling equipment will not be allowed to come in contact with the ground surface at any time during the sampling event.

The following paragraphs present the procedures that comprise groundwater/ surface water sample acquisition from all groundwater/ surface water sampling locations. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the Parsons ES field scientist's field notebook.

4.6.1 Preparation of Location

Prior to starting the sampling procedure, the area around the well or sampling location will be cleared of foreign materials, such as brush, rocks, and debris. These procedures will prevent sampling equipment from inadvertently contacting debris around the monitoring well. New, clean plastic (4 to 6 mil) we be placed around the well to prevent the contamination of both the ground surface and any equipment that may come into contact with the ground surface.

4.6.2 Water Level and Total Depth Measurements

Prior to removing any water from the well, the static water level will be measured. An electrical water level probe will be used to measure the depth to groundwater below the datum to the nearest 0.01 foot. If the total depth of the well is not known or is suspected to be inaccurate, total well depth will be measured by slowly lowering the water level probe to the bottom of the well. Total well depth will be measured to the nearest 0.01 foot. Total depth will only be measured when absolutely necessary to minimize the amount of sediment disturbance in the well. Based on water level and total depth information, the volume of water to be purged from the well can be calculated.

4.6.3 Well Purging

The static groundwater inside each well will be purged using a peristaltic pump. The well will be purged at a very low flow rate [10 milliliters per minute (ml/min) to 1,000 ml/min]. The objective of micropurging is to remove a small volume of water at a low flow rate from a discrete portion of the screened interval of the well without disturbing stagnant water within the casing. Therefore, the well purge rate must never be greater than the recharge rate of the well. During purging, the water level in the well will be monitored to ensure that no drawdown in the well occurs. The water level monitoring will allow the sampling technician to control pumping rates to minimize drawdown. As long as no drawdown is observed during pumping, it may be assumed that the low pumping rate within the discrete, screened portion of the well has not pulled stagnant casing water into the sample.

The pH, temperature, dissolved oxygen, and specific conductivity will be continuously monitored during well purging using a flow-through cell. The flow-through cell will be attached directly to the discharge tubing of the peristaltic pump using Teflon®-lined polyethylene tubing. New tubing will be used at each well. Purging will continue until the parameters have stabilized (less than 0.2 standard pH units or a 10-percent change for the other parameters over a 5-minute period) and the water is clear and free of fines. Research conducted on low-flow micropurging has found that dissolved oxygen and specific conductance readings are the most useful field indicator parameters for stabilization of background water chemistry during purging (Barcelona, *et. al.*, 1994). The research also concluded that stabilization of dissolved oxygen and specific conductance shows some correlation to stabilization of VOC concentrations in "formation" waters.

All purge water will be placed in DOT approved 55-gallon containers and disposed of properly. Parsons ES will be responsible for sampling, laboratory analysis, and arranging for the disposal of any contaminated or potentially contaminated purge and development water. Myrtle Beach AFB personnel, however, will be required to sign any hazardous materials manifests that may be created as part of the disposal process. Drums will be staged and temporarily stored onsite as directed by Myrtle Beach personnel.

4.6.4 Sample Extraction

A peristaltic pump with new tubing for each well will be used to extract groundwater samples from the wells at the MOGAS site. Bailers will be used only for those wells with known or suspected free product to minimize the potential for sampling equipment contamination. If depth to groundwater exceeds approximately 21 feet it will also be necessary to extract a sample using a bailer because of the vacuum lift limitations of a peristaltic pump. Both types of extraction equipment will be lowered into the water gently to prevent splashing and extracted gently to prevent creation of an excessive vacuum in the well. The sample will be transferred directly to the appropriate sample container. The water sample will be transferred from the bottom of the bailer using a bottom emptying device to allow a controlled flow into the sample container. Water from the peristaltic pump can be directly discharged into the sample container. The water should be carefully poured down the inner walls of the sample bottle to minimize aeration of the sample. Sample containers for VOC analysis will be filled at approximately 200 ml/min and all other sample collection rates will not exceed 400 ml/min. Volatile samples will be collected first, followed by any other analytical samples. Samples for field parameter analysis will be collected last.

Four surface water samples (SW-01 through SW-04) will be collected at the permanent surface water monitoring stations established along the drainage ditch that parallels Phyliss Drive on the south side of the MOGAS site (Figure 10.1). The samples will be collected along the approximate centerline of the drainage ditch to assess the impact of groundwater seeps on the surface water quality. Surface water samples will be collected directly into the sample bottle by submerging the sample bottle beneath the surface of the water in the ditch and allowing the water to slowly fill the bottle without exposure to the atmosphere. The sample bottle will be capped while submerged to prevent capture of air bubbles in the sample vial.

Unless other instructions are given by the analytical laboratory, sample containers will be completely filled so that no air space remains in the container. Excess water collected during sampling will be placed into the 55-gallon containers used for well purge waters and disposed of as directed by Myrtle Beach AFB personnel.

4.7 ONSITE CHEMICAL PARAMETER MEASUREMENT

Because many chemical parameters of a groundwater sample can change significantly within a short time following sample acquisition, these parameters will be measured in the field using Hach® or CHEMetrics® test kits. Table 10.1 in the body of the CAP list the chemical analytical protocol for groundwater samples. The following discussion describes the field procedures for obtaining the onsite chemical parameter measurements. For information on individual instrument calibration procedures, please refer to the manufacture calibration procedure for the instrument.

Groundwater quality measurements such as temperature, pH, specific conductivity, dissolved oxygen, and reduction/oxidation (redox) potential will be continuously monitored during well purging using a flow-through cell. The flow-through cell will be attached directly to the discharge tubing of the peristaltic pump using Teflon®-lined polyethylene tubing. A new piece of tubing will be used for each well. All groundwater quality measuring equipment will be decontaminated following the procedures described in Section 4.4. The groundwater quality measuring equipment will be calibrated between each well following the manufacturer's recommended calibration procedures. The measurements observed immediately before groundwater sampling begins will be considered the final measurements for the sample, and will be recorded in the field notebook and on the point-specific sampling form.

Groundwater quality measurements such as nitrate, nitrite, manganese, ferrous iron, sulfate, sulfide, and alkalinity will be measured in the field using HACH® or CHEMetrics® field analysis methods. All appropriate equipment and glassware associated with the field analysis of groundwater samples will be decontaminated following the procedures described in Section 4.4. Groundwater samples for these measurements will be collected after all sample containers for laboratory analyses have been collected. Two 250-ml bottles of groundwater will be collected and capped for field analysis. The field analysis of groundwater samples should begin immediately after collection. Direct sunlight, contact with air, and high temperatures may greatly affect the concentrations of the analytes in question. If possible, analyses will be run indoors, and groundwater samples will be capped and stored in a cooler with a temperature maintained at 4°C when not in use. Duplicate analyses will be run at a frequency of 25 percent, or one duplicate sample for every four field analyses. One blank (distilled water) analysis will be performed for each sampling round.

4.8 LABORATORY SAMPLE HANDLING

This section describes the handling of samples to be analyzed by the fixed-based laboratory from the time of sampling until the samples arrive at the laboratory.

4.8.1 Sample Container and Labels

Sample containers and appropriate container lids will be provided by the laboratory. The sample containers will be filled as described in Section 4.6.4, and the container lids will be tightly closed. Container lids will not be removed at any time prior to sample collection. The sample label will be firmly attached to the container side, and the following information will be legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample type (groundwater, surface water, etc.);
- Sampling date;
- Sampling time;
- Preservatives added; and
- Sample collector's initials.

4.8.2 Sample Preservation

The laboratory will add any necessary chemical preservatives prior to shipping the containers to the site. Samples will be properly prepared for transportation to the laboratory by placing the samples in a cooler containing ice to maintain a shipping temperature of 4°C.

4.8.3 Sample Shipment

After the samples are sealed and labeled, they will be packaged for transport to Evergreen Analytical, Inc. of Wheat Ridge, Colorado, the AFCEE-approved laboratory for this demonstration. Samples will be shipped priority overnight via Federal Express®. The following packaging and labeling procedures will be followed:

- Package sample so that it will not leak, spill, or vaporize from its container;
- Label shipping container with:
  - Sample collector's name, address, and telephone number;
  - Laboratory's name, address, and telephone number;
  - Description of sample;
  - Quantity of sample; and
  - Date of shipment.

The packaged samples will be delivered to the laboratory as soon as possible after sample acquisition, and within method-specific holding times.

4.8.4 Chain-of-Custody Control

After the samples have been collected, chain-of-custody procedures will be followed as described in Section 3.4.4.

4.8.5 Sampling Records

In order to provide complete documentation of the sampling event, detailed records will be maintained by the Parsons ES field hydrogeologist. At a minimum, these records will include the following information:

- Sample location (facility name);
- Sample identification;
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observations of
    - Sample appearance,
    - Sample odor;
- Weather conditions;
- Water level prior to purging;
- Total well depth;
- Purge volume;
- Water level after purging;
- Well condition;
- Sampler's identification;
- Field measurements of pH, temperature, and specific conductivity; and
- Any other relevant information.

Ground Water Sampling Record

SAMPLING LOCATION ____________
SAMPLING DATE(S)____________

GROUND WATER SAMPLING RECORD - MONITORING WELL ____________
(number)

REASON FOR SAMPLING: [ ] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: ____________, 19__ ________ a.m./p.m.
SAMPLE COLLECTED BY: ____________ of ____________
WEATHER:____________
DATUM FOR WATER DEPTH MEASUREMENT (Describe):____________

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:____________
INNER PVC CASING CONDITION IS:____________
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):____________

Check-off
1 [ ] EQUIPMENT CLEANED BEFORE USE WITH____________
Items Cleaned (List):____________

2 [ ] WATER DEPTH ____________ FT. BELOW DATUM
Measured with:____________

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:____________
Odor:____________
Other Comments:____________

4 [ ] WELL EVACUATION:
Method:____________
Volume Removed:____________
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:____________
Other comments:____________

Figure 4.1

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: ________________________________
[ ] Pump, type: ________________________________
[ ] Other, describe: ________________________________
____

Sample obtained is [ ] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Temp: __________ ° ______ Measured with: ______________
pH: ________________ Measured with: ______________
Conductivity: __________ Measured with: ______________
Other: ________________________________
____

7 [ ] SAMPLE CONTAINERS (material, number, size): ______________
____
____
____

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method __________ Containers: __________
Method __________ Containers: __________
Method __________ Containers: __________

[ ] Preservatives added:

Method __________ Containers: __________
Method __________ Containers: __________
Method __________ Containers: __________
Method __________ Containers: __________

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: ________________________________
____
____
____
____

Figure 4.1 (Continued)

Groundwater/ surface water sampling activities will be recorded on a groundwater sampling form or in the field scientist's field notebook. Figure 4.1 shows an example of the groundwater sampling record.

4.9 LABORATORY ANALYSES

Laboratory analyses will be performed on all groundwater/ surface water samples and the required QA/QC samples (see Section 4.10). The analytical methods and detection limit requirements for this sampling event are listed in Table 10.1 in the body of the CAP. Evergreen Analytical Laboratories of Wheat Ridge, CO, will be perform the laboratory analytical analyses.

Prior to sampling, arrangements will be made with the laboratory to provide a sufficient number of appropriate sample containers for the samples to be collected. All containers, preservatives, and shipping requirements will be consistent with laboratory protocol.

Laboratory personnel will specify any additional QC samples and prepare bottles for all samples. For samples requiring chemical preservation, preservatives will be added to containers by the laboratory prior to shipping. Shipping containers with adequate padding and cooling media will be sent by the laboratory to the site. Sampling personnel will fill the sample containers and return the samples to the laboratory.

4.10 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND SAMPLING

Field QA/QC samples for groundwater/ surface water sampling will include collection of field duplicates; equipment rinseate samples, and field, and trip blanks; decontamination of the water level probe; use of analyte-appropriate containers; and chain-of-custody procedures for sample handling and tracking. All samples to be transferred to the analytical laboratory for analysis will be clearly labeled to indicate sample number, location, matrix (e.g., groundwater/ surface water), and analyses requested. Samples will be preserved in accordance with the analytical methods to be used, and water sample containers will be packaged in coolers with ice to maintain an approximate temperature of 4°C.

All field sampling activities will be recorded in a bound, sequentially paginated field notebook in permanent ink. All sample collection entries will include the date, time, sample locations and numbers, notations of field observations, and the sampler's name and signature.

Groundwater/ surface water QA/QC sampling frequency will be 10 percent or one sample for every ten wells/locations sampled. In the event that less than ten wells will be sampled in an event, a minimum of one sample will be collected. This ten percent frequency also applies to equipment rinseate samples and field duplicates. One decontamination water sample and one field blank will be collected per sampling event. One trip blank will be sent with each sample shipment. The procedures for the collection of field QA/QC samples are described in Section 5. The laboratory should

plan to conduct one matrix spike analysis, one laboratory control sample, and one laboratory blank test for each specific analysis requested.

SECTION 5

FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

As a check on field sampling, QA/QC samples will be collected during each sampling event. Definitions for field QA/QC samples are presented below.

5.1 FIELD DUPLICATES

A field duplicate is defined as two or more samples collected independently at the same sampling location during a single act of sampling. Soil samples are divided into two equal parts (replicates) for analysis. Field duplicates will be indistinguishable from other samples by the laboratory. Each of the field duplicates will be uniquely identified with a coded identifier, which will be in the same format as other sample identifiers. Duplicate sample results are used to assess the precision of the sample collection process. During the collection of VOC samples, compositing should not be performed due to the potential for target compound loss. Ten percent of all field samples will be field duplicates.

5.2 TRIP BLANKS

The trip blank is used to indicate potential contamination by VOCs during sample shipping and handling. A trip blank consists of analyte-free laboratory reagent water in a 40-milliliter (ml) glass vial sealed with a Teflon® septum. The blank accompanies the empty sample bottles to the field and is placed in each cooler containing water or soil matrix VOC samples returning to the laboratory for analysis. The trip blank is not opened until analysis in the laboratory with the corresponding site samples.

5.3 EQUIPMENT RINSEATE BLANKS

Equipment rinseate blanks consist of reagent grade water poured into or pumped through the sampling device following decontamination. The rinseate is transferred to an appropriate sample bottle for the analysis and transported to the laboratory. The equipment rinseate samples are analyzed for the same laboratory parameters as the site samples. Equipment blanks are used to measure to contamination introduced to a sample set from improperly decontaminated sampling equipment.

5.4 DECONTAMINATION WATER BLANK

A decontamination water blank is designed to check the purity of potable water used for equipment decontamination during the field operation. One decontamination water blank will be collected for each water source used during the field work.

Decontamination water blanks are collected by filling the appropriate sample container directly from the potable water source. Decontamination water blanks are labeled, preserved, handled, and shipped in the same manner as an environmental water sample. The blank will be analyzed for the same analytes and parameters as the environmental samples.

5.5 FIELD BLANKS

A field blank is designed to assess the effects of ambient field conditions on sample results. A field blank will consist of a sample of reagent grade water poured into a laboratory-supplied sample container while sampling activities are underway. The field blank will be analyzed for the same analytes and parameters as the environmental samples.

SECTION 6

FIELD DATA REDUCTION, VALIDATION, AND REPORTING

The following sections describe field analytical instrumentation calibration, and field data reporting, validation, reduction, and review.

6.1 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD TEST EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data in the field will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Field instruments may include a pH meter, digital thermometer, O_2/CO_2 meter, TVH meter, specific conductivity meter, dissolved oxygen meter, oxidation reduction potential meter, and Hach® spectrophotometer. A summary of calibration frequency and acceptance criteria is presented in Table 6.1.

6.2 FIELD DATA REDUCTION

During processing of field data, validation checks will be performed by individuals designated by the project manager. The purpose of these checks is to identify outliers; that is, data which do not conform within two standard deviations to the pattern established by other observations. The Students "t" test will be used to identify outliers when the total number of samples is less than 31, and the normal distribution will be used to identify others when the total number of samples is greater than 31. Although outliers may be the result of transcription errors or instrument breakdowns, they may also be manifestations of a greater degree of spatial or temporal variability than expected. Therefore, after an outlier has been identified, a decision must be made concerning its further use. Obvious mistakes in data will be corrected when possible, and the corrected values will be inserted. If the correct value cannot be obtained, the datum may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, and a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier both when included in and when excluded from the data set, and the results will be discussed in the report. In addition, the data will be compared against those obtained in previous investigations (where available) and against applicable standards and guidelines.

6.3 REVIEW OF FIELD RECORDS

All field records are evaluated for the following:

TABLE 6.1
FIELD SCREENING METHODS ANALYTICAL PROTOCOL
SUMMARY OF QC [a] PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO REMEDIATION

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[b]	Reporting Limit
SW9050	Conductance	Calibration with potassium chloride standard	Once per day at beginning of testing	± 5%	If calibration is not achieved, check meter, standards, and probe; recalibrate	0.02 µmhos/cm
		Field duplicate	10% of field samples	± 5%	Correct problem, repeat measurement	
SW9040	pH (water)	2-point calibration with pH buffers	Once per day at beginning of testing	± 0.05 pH units for every buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration	pH units
		pH 7 buffer	At each sample location	± 0.1 pH units	Correct problem, recalibrate	
		Field duplicate	10% of field samples	± 0.1 pH units	Correct problem, repeat measurement	
E170.1	Temperature	Field duplicate	10% of field samples	± 1.0°C[c]	Correct problem, repeat measurement	°C
ASTM[d] D1498	Oxidation-reduction potential	Calibration with one standard	Once per day at beginning of testing	Two successive readings ± 10 millivolts	Correct problem, recalibrate	pe[e] units
		Field duplicate	10% of field samples	± 10 millivolts	Correct problem, repeat measurement	
Hach™ 8221	Alkalinity	Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by standard solutions, and optical cell; replace if necessary; repeat calibration check	20.0 mg/L[f]
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	

TABLE 6.1 (Continued)
FIELD SCREENING METHODS ANALYTICAL PROTOCOL
SUMMARY OF QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO REMEDIATION

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]	Reporting Limit
E360.1	Dissolved oxygen	Calibration check with one standard, and zero meter with sodium sulfate solution	Once per day at beginning of testing	± 5 %	Correct problem by checking meter, standard solutions, replace if necessary; repeat calibration check	0.5 mg/L
		Field duplicate	10% of field samples	RPD[g/] < 20%	Correct problem, repeat measurement	
HACH™ 8039	Nitrate (NO_3)	Calibration check with one standard, and zero meter w/sodium sulfate solution	Once per day at beginning of testing	± 5 %	Correct problem by checking meter, standard solutions, replace if necessary; repeat calibration check	0.07 mg/L
		Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	
HACH™ 8040	Nitrite (NO_2)	Calibration check with one standard	Once per day at beginning of testing	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	0.01 mg/L
		Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	

TABLE 6.1 (Continued)
FIELD SCREENING METHODS ANALYTICAL PROTOCOL
SUMMARY OF QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO REMEDIATION

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]	Reporting Limit
Hach™ 8146	Ferrous Iron (Fe^{2+})	Calibration check with one standard	Once per day at beginning of testing	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	0.024 mg/L
		Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	
Hach™ 8034	Manganese	Calibration check with one standard	Once per day at beginning of testing	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	0.024 mg/L
		Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	
Hach™ 8131	Hydrogen Sulfide (H_2S)	Calibration check with one standard	Once per day at beginning of testing	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	0.024 mg/L

TABLE 6.1 (Continued)
FIELD SCREENING METHODS ANALYTICAL PROTOCOL
SUMMARY OF QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO REMEDIATION

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[b/]	Reporting Limit
Hach™ 8131	Hydrogen Sulfide (H_2S)	Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	
HACH™ 8051	Sulfate (SO_4^{-2})	Calibration check with one standard	Once per day at beginning of testing	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	0.01 mg/L
		Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	
HACH™ 8131	Sulfide (S^{-2})	Calibration check with one standard	Once per day at beginning of testing	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	NA[h/]
		Accuracy check, (3 concentration points)	Once per day	± 50 %	Correct problem by checking meter, standard solutions, and optical cell; replace if necessary; repeat calibration check	
		Field duplicate	10% of field samples	± 10 %	Correct problem, repeat measurement	

a/ QC = quality control.
b/ All corrective actions will be documented, and the records will be maintained by the prime contractor.
c/ °C = degrees Celsius.
d/ ASTM = American Society for Testing and Materials.
e/ pc = potential platinum electrode.
f/ mg/L = milligrams per liter.
g/ RPD = relative percent difference.
h/ NA = not applicable.

Completeness of field records. The check of field record completeness will ensure that all requirements for field activities have been fulfilled, complete records exist for each field activity, and that the procedures specified in the SAP (or approved as field change requests) were implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event. The results of the completeness check will be documented, and environmental data affected by incomplete records will be identified in the technical report.

Identification of valid samples. The identification of valid samples involves interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples. For example, field records can indicate whether a well is properly constructed or if unanticipated environmental conditions were encountered during construction. The lithologic and geophysical logs may be consulted to determine if a well is screened only in the water-bearing zone of concern. Records also should note sample properties such as clarity, color, odor, etc. Photographs may show the presence or absence of obvious sources of potential contamination, such as operating combustion engines near a well during sampling. Judgments of sample validity will be documented in the technical report, and environmental data associated with poor or incorrect field work will be identified.

Correlation of data. The results of field tests obtained from similar areas will be correlated. For example, soil gas readings and VOC analysis results may be correlated. The findings of these correlations will be documented, and the significance of anomalous data will be discussed in the technical report.

Identification of anomalous field test data. Anomalous field data will be identified and explained to the extent possible. For example, a water temperature for one well that is significantly higher than any other well temperature in the same aquifer will be explained in the technical report.

Accuracy and precision of field data and measurements. The assessment of the quality of field measurements will be based on instrument calibration records and a review of any field corrective actions. The accuracy and precision of field measurements will be discussed.

Field record review is an ongoing process. Field team leaders will be responsible for ensuring that proper documentation is recorded during each site's sampling activities.

6.4 FIELD DATA VALIDATION AND REPORTING

The contractor analyst will review 100 percent of all screening data prior to reporting. Screening data will constitute all analytical method results from analyses performed in the field laboratory environment. The contractor will determine if their data quality objectives (DQOs) for field data have been met, and also will calculate the percent complete (PC) for field data results.

At a minimum, the review of screening data will focus on the following topics:

- Holding times;
- Method blanks;
- Field instrumentation detection limits;
- Analytical batch control records including calibrations, and spike recoveries;
- Completeness of data; and
- Flag all results with an "S" to denote sample results from field screening versus fixed laboratory results.

Field data will be validated using four different procedures, as described below.:

- Routine checks (e.g., looking for errors in identification codes) will be made during the processing of data.
- Internal consistency of a data set will be evaluated. This step will involve plotting the data and testing for outliers.
- Checks for consistency of the data set over time will be performed. This can be accomplished by comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified.
- Checks may be made for consistency with parallel data sets. An example of such a check would be comparing data from the same region of the aquifer or volume of soil.

SECTION 7

FIXED-BASE LABORATORY ANALYTICAL PROCEDURES

Application of a specific analytical method depends on the sample matrix and the analytes to be identified. Methods for each of the parameters likely to be included in the analytical program, as well as detection limits, are discussed in the following subsections. All analytical methods are USEPA approved.

7.1 ANALYTICAL METHODS

Analytical procedures will follow the established USEPA and/or American Society for Testing and Materials (ASTM) methods as recommended by AFCEE wherever such methods exist for a specified analyte. All approved methods are presented in Table 7.1. The referenced methods are defined in the following documents:

- USEPA (1983) *Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-79-020.
- USEPA (1995) *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods*, SW846, 3rd Edition , Update IIB.
- *American Society for Testing and Materials Methods* (ASTM, 1995).

7.1.2 Detection and Quantitation Limits

This section describes the terms, definitions, and formulas that will be used for detection and quantitation limits.

7.1.3 Instrument Detection Limit

The instrument detection limit (IDL) reflects the instrument operating efficiency, not sample preparation or concentration/dilution factors. The IDL is operationally defined as three times the standard deviation of seven replicate analyses of the lowest concentration that is statistically different from a blank. This represents 99-percent confidence that the signal identified is the result of the presence of the analyte, and not random noise.

7.1.4 Method Detection Limit

The method detection limit (MDL) is the lowest concentration at which a specific analyte in a matrix can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. MDLs are experimentally determined and

TABLE 7.1
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Water		Soil	
		PQL[a]	Unit	PQL	Unit
Aromatic Volatile Organics Compounds SW5030A/SW8020A (W[d], S[e])	1,2-Dichlorobenzene	4.0	µg/L[b]	0.004	mg/kg[c]
	1,3-Dichlorobenzene	4.0	µg/L	0.004	mg/kg
	1,4-Dichlorobenzene	3.0	µg/L	0.003	mg/kg
	Benzene	2.0	µg/L	0.002	mg/kg
	Chlorobenzene	2.0	µg/L	0.002	mg/kg
	Ethylbenzene	2.0	µg/L	0.002	mg/kg
	Toluene	2.0	µg/L	0.002	mg/kg
	Xylenes, Total	2.0	µg/L	0.002	mg/kg
Methane SW3810 Modified (W)	Methane	2.0	µg/L	NA[f]	NA
	Ethane	4.0	µg/L	NA	NA
	Ethene	2.0	µg/L	NA	NA
Volatile Organics SW5030A/SW8260A (W, S)	1,1,1,2-Tetrachloroethane	0.5	µg/L	0.003	mg/kg
	1,1,1-Trichloroethane	0.8	µg/L	0.004	mg/kg
	1,1,2,2-Tetrachloroethane	0.4	µg/L	0.002	mg/kg
	1,1,2-Trichloroethane	1.0	µg/L	0.005	mg/kg
	1,1-Dichloroethane	0.4	µg/L	0.002	mg/kg
	1,1-Dichloroethene	1.2	µg/L	0.006	mg/kg
	1,1-Dichloropropene	1.0	µg/L	0.005	mg/kg
	1,2,3-Trichlorobenzene	0.3	µg/L	0.002	mg/kg
	1,2,3-Trichloropropane	3.2	µg/L	0.02	mg/kg
	1,2,4-Trichlorobenzene	0.4	µg/L	0.002	mg/kg
	1,2,4-Trimethylbenzene	1.3	µg/L	0.007	mg/kg
	1,2-Dichloroethane	0.6	µg/L	0.003	mg/kg
	1,2-Dichlorobenzene	0.3	µg/L	0.002	mg/kg
	1,2-Dibromo-3-Chloropropane	2.6	µg/L	0.01	mg/kg
	1,2-Dichloropropane	0.4	µg/L	0.002	mg/kg
	1,2-Dibromoethane	0.6	µg/L	0.003	mg/kg
	1,3,5-Trimethylbenzene	0.5	µg/L	0.003	mg/kg
	1,3-Dichlorobenzene	1.2	µg/L	0.006	mg/kg
	1,3-Dichloropropane	0.4	µg/L	0.002	mg/kg

TABLE 7.1 (Continued)
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Water PQL[a]	Water Unit	Soil PQL	Soil Unit
Volatile Organics (Cont)	1,4-Dichlorobenzene	0.3	µg/L	0.002	mg/kg
SW5030A/SW8260A	1-Chlorohexane	0.5	µg/L	0.003	mg/kg
(W, S)	2,2-Dichloropropane	3.5	µg/L	0.02	mg/kg
	2-Chlorotoluene	0.4	µg/L	0.002	mg/kg
	4-Chlorotoluene	0.6	µg/L	0.003	mg/kg
	Benzene	0.4	µg/L	0.002	mg/kg
	Bromobenzene	0.3	µg/L	0.002	mg/kg
	Bromochloromethane	0.4	µg/L	0.002	mg/kg
	Bromodichloromethane	0.8	µg/L	0.004	mg/kg
	Bromoform	1.2	µg/L	0.006	mg/kg
	Bromomethane	1.1	µg/L	0.005	mg/kg
	Carbon Tetrachloride	2.1	µg/L	0.01	mg/kg
	Chlorobenzene	0.4	µg/L	0.002	mg/kg
	Chloroethane	1.0	µg/L	0.005	mg/kg
	Chloroform	0.3	µg/L	0.002	mg/kg
	Chloromethane	1.3	µg/L	0.007	mg/kg
	Cis-1,2-Dichloroethene	1.2	µg/L	0.006	mg/kg
	Cis-1,3-Dichloropropene	1.0	µg/L	0.005	mg/kg
	Dibromochloromethane	0.5	µg/L	0.003	mg/kg
	Dibromomethane	2.4	µg/L	0.01	mg/kg
	Dichlorodifluoromethane	1.0	µg/L	0.005	mg/kg
	Ethylbenzene	0.6	µg/L	0.003	mg/kg
	Hexachlorobutadiene	1.1	µg/L	0.005	mg/kg
	Isopropylbenzene	0.5	µg/L	0.008	mg/kg
	m-Xylene	0.5	µg/L	0.003	mg/kg
	Methylene Chloride	0.3	µg/L	0.002	mg/kg
	n-Butylbenzene	1.1	µg/L	0.005	mg/kg
	n-Propylbenzene	0.4	µg/L	0.002	mg/kg
	Naphthalene	0.4	µg/L	0.002	mg/kg
	o-Xylene	1.1	µg/L	0.005	mg/kg
	p-Isopropyltoluene	1.2	µg/L	0.006	mg/kg
	p-Xylene	1.3	µg/L	0.007	mg/kg

TABLE 7.1 (Continued)
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Water		Soil	
		PQL[a]	Unit	PQL	Unit
Volatile Organics (Cont)	Sec-Butylbenzene	1.3	µg/L	0.007	mg/kg
SW5030A/SW8260A	Styrene	0.4	µg/L	0.002	mg/kg
(W, S)	Tricholoroethene	1.0	µg/L	0.01	mg/kg
	Tert-Butylbenzene	1.4	µg/L	0.007	mg/kg
	Tetrachloroethylene	1.4	µg/L	0.007	mg/kg
	Toluene	1.1	µg/L	0.005	mg/kg
	Trans-1,2-Dichloroethene	0.6	µg/L	0.003	mg/kg
	Trans-1,3-Dichloropropene	1.0	µg/L	0.005	mg/kg
	Trichlorofluoromethane	0.8	µg/L	0.004	mg/kg
	Vinyl Chloride	1.1	µg/L	0.009	mg/kg
Semivolatile Organics	1,2,4-Trichlorobenzene	10.0	µg/L	0.7	mg/kg
Base/Neutral Extractables	1,2-Dichlorobenzene	10.0	µg/L	0.7	mg/kg
SW3510B/SW8270B (W)	1,3-Dichlorobenzene	10.0	µg/L	0.7	mg/kg
SW3550A/SW8270B (S)	1,4-Dichlorobenzene	10.0	µg/L	0.7	mg/kg
	2,4-Dinitrotoluene	10.0	µg/L	0.7	mg/kg
	2,6-Dinitrotoluene	10.0	µg/L	0.7	mg/kg
	2-Chloronaphthalene	10.0	µg/L	0.7	mg/kg
	2-Methylnaphthalene	10.0	µg/L	0.7	mg/kg
	2-Nitroaniline	50.0	µg/L	3.3	mg/kg
	3-Nitroaniline	50.0	µg/L	3.3	mg/kg
	3.3'-Dichlorobenzidine	20.0	µg/L	1.3	mg/kg
	4-Bromophenyl Phenyl Ether	10.0	µg/L	0.7	mg/kg
	4-Chloroaniline	20.0	µg/L	1.3	mg/kg
	4-Chlorophenyl Phenyl Ether	10.0	µg/L	0.7	mg/kg
	4-Nitroaniline	50.0	µg/L	3.3	mg/kg
	Acenaphthylene	10.0	µg/L	0.7	mg/kg
	Acenapthene	10.0	µg/L	0.7	mg/kg
	Anthracene	10.0	µg/L	0.7	mg/kg
	Benz (a) Anthracene	10.0	µg/L	0.7	mg/kg
	Benzo (a) Pyrene	10.0	µg/L	0.7	mg/kg
	Benzo (b) Fluoranthene	10.0	µg/L	0.7	mg/kg
	Benzo (g,h,i) Perylene	10.0	µg/L	0.7	mg/kg

TABLE 7.1 (Continued)
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Water PQL[a/]	Water Unit	Soil PQL	Soil Unit
Semivolatile Organics	Benzyl Alcohol	20.0	µg/L	1.3	mg/kg
Base/Neutral Extractables	Bis (2-Chlorethyl) Ether	10.0	µg/L	0.7	mg/kg
SW3510B/SW8270B (W)	Bis (2-Chloroethoxy) Methane	10.0	µg/L	0.7	mg/kg
SW3550A/SW8270B (S)	Bis (2-Chloroisopropyl) Ether	10.0	µg/L	0.7	mg/kg
(Cont)	Bis (2-Ethylhexyl) Phthalate	10.0	µg/L	0.7	mg/kg
	Butyl Benzylphthalate	10.0	µg/L	0.7	mg/kg
	Chrysene	10.0	µg/L	0.7	mg/kg
	Di-n-Butylphthalate	10.0	µg/L	0.7	mg/kg
	Di-n-Octylphthalate	10.0	µg/L	0.7	mg/kg
	Dibenz (a,h) Anthracene	10.0	µg/L	0.7	mg/kg
	Dibenzofuran	10.0	µg/L	0.7	mg/kg
	Diethyl Phthalate	10.0	µg/L	0.7	mg/kg
	Dimethly Phthalate	10.0	µg/L	0.7	mg/kg
	Fluoranthene	10.0	µg/L	0.7	mg/kg
	Fluorene	10.0	µg/L	0.7	mg/kg
	Hexachlorobenzene	10.0	µg/L	0.7	mg/kg
	Hexachlorobutadiene	10.0	µg/L	0.7	mg/kg
	Hexachlorocyclopentadiene	10.0	µg/L	0.7	mg/kg
	Hexachloroethane	10.0	µg/L	0.7	mg/kg
	Indeno (1,2,3-cd) Pyrene	10.0	µg/L	0.7	mg/kg
	Isophorone	10.0	µg/L	0.7	mg/kg
	n-Nitrosodiphenylamine	10.0	µg/L	0.7	mg/kg
	n-Nitrosodi-n-Propylamine	10.0	µg/L	0.7	mg/kg
	Naphthalene	10.0	µg/L	0.7	mg/kg
	Nitrobenzene	10.0	µg/L	0.7	mg/kg
	Phenanthrene	10.0	µg/L	0.7	mg/kg
	Pyrene	10.0	µg/L	0.7	mg/kg
Semivolatile Organics	2,4,5-Trichlorophenol	50.0	µg/L	3.3	mg/kg
Acid Extractables	2,4,6-Trichlorophenol	10.0	µg/L	0.3	mg/kg
SW3510B/SW8270B (W)	2,4-Dichlorophenol	10.0	µg/L	0.3	mg/kg
SW3550A/SW8270B (S)	2,4-Dimethylphenol	10.0	µg/L	0.3	mg/kg
	2,4-Dinitrophenol	50.0	µg/L	3.3	mg/kg

TABLE 7.1 (Continued)
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Water PQL[a]	Water Unit	Soil PQL	Soil Unit
Semivolatile Organics	2-Chlorophenol	10.0	µg/L	0.3	mg/kg
Acid Extractables	2-Methylphenol	10.0	µg/L	0.3	mg/kg
SW3510B/SW8270B (W)	2-Nitrophenol	10.0	µg/L	0.3	mg/kg
SW3550A/SW8270B (S)	4,6-Dinitro-2-Methylphenol	50.0	µg/L	3.3	mg/kg
(Cont)	4-Chloro-3-Methylphenol	20.0	µg/L	1.3	mg/kg
	4-Methylphenol	10.0	µg/L	0.3	mg/kg
	4-Nitrophenol	50.0	µg/L	1.6	mg/kg
	Benzoic Acid	50.0	µg/L	1.6	mg/kg
	Pentachlorophenol	50.0	µg/L	3.3	mg/kg
	Phenol	10.0	µg/L	0.3	mg/kg
Polynuclear Aromatic	Acenaphthene	18.0	µg/L	1.2	mg/kg
Hydrocarbons	Acenaphthylene	23.0	µg/L	1.54	mg/kg
SW3510B/SW8310 (W)	Anthracene	6.6	µg/L	0.44	mg/kg
SW3550A/SW8310 (S)	Benz (a) Anthracene	0.13	µg/L	0.009	mg/kg
	Benzo (a) Pyrene	0.23	µg/L	0.015	mg/kg
	Benzo (b) Fluoranthene	0.18	µg/L	0.012	mg/kg
	Benzo (g,h,i) Perylene	0.76	µg/L	0.05	mg/kg
	Benzo (k) Fluoranthene	0.17	µg/L	0.011	mg/kg
	Chrysene	1.5	µg/L	0.1	mg/kg
	Dibenzo (a,h) Anthracene	0.3	µg/L	0.02	mg/kg
	Fluoranthrene	2.1	µg/L	0.14	mg/kg
	Fluorene	2.1	µg/L	0.14	mg/kg
	Indeno (1,2,3-c,d) Pyrene	0.43	µg/L	0.03	mg/kg
	Naphthalene	18.0	µg/L	1.2	mg/kg
	Phenanthrene	6.4	µg/L	0.42	mg/kg
	Pyrene	2.7	µg/L	0.18	mg/kg
ICP Screen for Metals	Aluminum	0.5	mg/L[g]	50.0	mg/kg
SW3005A/SW6010A (W)	Antimony	0.4	mg/L	40.0	mg/kg
SW3050A/SW6010A (S)	Arsenic	0.6	mg/L	60.0	mg/kg
	Barium	0.02	mg/L	2.0	mg/kg
	Beryllium	0.003	mg/L	0.3	mg/kg
	Cadmium	0.04	mg/L	4.0	mg/kg

I:\IN\CHRLSTON\SAPT71.WW6

TABLE 7.1 (Continued)
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Parameter/Method	Analyte	Water PQL[a/]	Water Unit	Soil PQL	Soil Unit
ICP Screen for Metals	Calcium	0.1	mg/L	10.0	mg/kg
SW3005A/SW6010A (W)	Chromium	0.07	mg/L	7.0	mg/kg
SW3050A/SW6010A (S)	Cobalt	0.07	mg/L	7.0	mg/kg
(Cont)	Copper	0.06	mg/L	6.0	mg/kg
	Iron	0.07	mg/L	7.0	mg/kg
	Lead	0.5	mg/L	50.0	mg/kg
	Magnesium	0.3	mg/L	30.0	mg/kg
	Manganese	0.02	mg/L	2.0	mg/kg
	Molybdenum	0.08	mg/L	8.0	mg/kg
	Nickel	0.15	mg/L	15.0	mg/kg
	Potassium	5.0	mg/L	500.0	mg/kg
	Selenium	0.8	mg/L	80.0	mg/kg
	Silver	0.07	mg/L	7.0	mg/kg
	Sodium	0.3	mg/L	30.0	mg/kg
	Thallium	0.4	mg/L	40.0	mg/kg
	Vanadium	0.08	mg/L	8.0	mg/kg
	Zinc	0.02	mg/L	2.0	mg/kg
SW3020A/SW7421 (W) SW3050A/SW7421 (S)	Lead	0.005	mg/L	0.5	mg/kg
Common Anions	Bromide	0.1	mg/L	0.1	mg/kg
SW9056	Chloride	0.2	mg/L	0.2	mg/kg
	Fluoride	0.2	mg/L	0.2	mg/kg
	Nitrate	0.1	mg/L	0.1	mg/kg
	Nitrite	0.4	mg/L	0.1	mg/kg
	Phosphate	0.1	mg/L	0.1	mg/kg
	Sulfate	0.2	mg/L	0.2	mg/kg
E160.1	Total Dissolved Solids	10.0	mg/L	NA	NA
E160.2	Total Suspended Solids	5.0	mg/L	NA	NA
E310.1	Alkalinity	10.0	mg/L	NA	NA
E353.1	Nitrogen, Nitrate/Nitrite	0.1	mg/L	NA	NA
SW9050	Conductance	NA	NA	NA	NA
SW9040	pH	NA	NA	NA	NA

TABLE 7.1 (Continued)
PRACTICAL QUANTITATION LIMITS
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

SOURCE: AFCEE QAPP, Version 1.1, February 1996

[a] PQLs = practical quantitation limits. PQLs are equal to the project reporting limits.
[b] µg/L = micrograms per liter.
[c] mg/kg = milligrams per kilogram.
[d] W = water.
[e] S = soil.
[f] NA = not applicable.
[g] mg/L = milligrams per liter.

verified for each target analyte of the methods in the sampling program. The laboratory will determine MDLs for each analyte and matrix type prior to analysis of project samples. MDLs are based on the results of seven matrix spikes at the estimated MDL, and are statistically calculated in accordance with the Title 40, Code of Federal Regulations Part 136 (40 CFR 136). The standard deviation of the seven replicates is determined and multiplied by 3.14 (i.e., the 99-percent confidence interval from the one-sided Students T-test). MDLs must be determined annually as a minimum. The MDLs to be used are intended to allow that both nondetects and detects will be usable to the fullest extent possible for the project.

7.1.5 Project Reporting Limit

To define analytical data reporting limits that meet project DQOs, potential risk-based screening criteria were identified. State-specified "clean closure" concentrations, risk-based preliminary remediation goals (PRGs), regulatory concentrations, or other relevant soil, groundwater, and surface water action levels will be reviewed to identify the most stringent comparison criteria for each matrix likely to be applicable. The project reporting limits (PRLs), listed as the practical quantitation limits (PQL) in Table 7.1, will be reviewed in comparison to the risk-based screening criteria.

The PRL is equivalent to the current PQL guidance listed in the AFCEE (1996) QAPP. Because the project remediation goals are developed for risk-based site closure, all sample results will be the reported at or above the MDL for each analyte. All results above the MDL but below the PQL will be qualified in the data deliverable from the laboratory with a "FJ" flag. The "FJ" flag will denote the sample result as below the PQL (see Section 7.6.2). Where practical, MDLs must be lower than the risk-based criterion determined for the project. Laboratories must verify the PRLs by analyzing a standard at or below the PRL within the calibration curve.

All analytical results for soils (both nondetected and detected) will be reported on a dry-weight basis (i.e., corrected for moisture content). The moisture content for each soil sample will be reported. The equation for moisture content given for the SW-846 Method SW3550 is as follows:

$$\frac{\text{Initial Weight - Dried Weight}}{\text{Initial Weight}} \times 100 = \%\ \text{moisture}$$

The result of the sample on a dry-weight basis is as follows:

$$\frac{\text{Result of analysis on wet weight basis}}{100 - \%\ \text{Moisture}} = \text{Result of analysis on a dry-weight basis}$$

7.1.6 Sample Quantitation Limit

Sample quantitation limits (SQLs) are defined as the MDL multiplied by the dilution factor (DF) required to analyze the sample, and corrected for moisture or sample size. These adjustments may be due to matrix effects or to the high concentrations of some analytes. For example, if an analyte is present at a concentration that is greater than

the linear range of the analytical method, the sample must be diluted for accurate quantitation. The DF raises the reporting limit, which then becomes the SQL. Because the reported SQLs take into account sample characteristics and analytical adjustments, they are the most relevant quantitation limits for evaluating nondetected chemicals.

7.1.7 Reporting Units

The following are the prescribed reporting units for all analytical methods:

Soil and sediment samples - organics: micrograms per kilogram (μg/kg), dry-weight basis;

Soil and sediment samples - inorganics/metals: milligrams per kilogram (mg/kg), dry-weight basis;

Water samples - inorganics/metals: milligrams per liter (mg/L); and

Water samples - organics: micrograms per liter (μg/L).

7.2 LABORATORY QUALITY CONTROL DATA

Laboratory QC data are necessary to determine the precision and accuracy of the analyses, confirm matrix interferences, and demonstrate target compound contamination of sample results. QC samples will be analyzed routinely by the analytical laboratory as part of the laboratory QC procedures. Contract laboratories performing definitive data quality analyses require a more stringent QC program than those performing screening-level data quality analyses. Definitions for QC samples are presented below. Frequency and acceptance requirements are defined in Table 7.2. All precision and accuracy control limit criteria are defined in Table 1.1.

7.2.1 Holding Time

Holding times for sample extraction and/or analysis as required by the methods will be met for all samples. The holding time is calculated from the date and time of sample collection to the time of sample preparation and/or analysis. All sample analyses to include dilutions and second-column confirmation will meet the required holding times. Results for samples exceeding holding time will be qualified as unusable (flagged "R"). Table 7.3 defines applicable method-specific analytical holding times.

7.2.3 Method Blanks

Method blanks are designed to detect contamination of the field samples in the laboratory environment. Method blanks verify that interferences caused by contaminants in solvents, reagents, glassware, or in other sample processing hardware are known and minimized. The method blank will be ASTM Type II water (or equivalent) for water samples, and a purified solid matrix (Ottawa sand or equivalent) for soil samples. The concentration of target compounds in the blanks must be less than

TABLE 7.2
SUMMARY OF CALIBRATION AND QC[a/] PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[b/]
Aromatic Volatile Organics Compounds SW8020A	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD[c/] < 20% for CFs[d/] or RFs[e/]	Correct problem then repeat initial calibration
	Second-source calibration verification	Once per five-point initial calibration	All analytes within ±15% of expected value	Correct problem then repeat initial calibration
	Retention time window calculated for each analyte	Each initial calibration and calibration verification	* 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check
	Initial calibration verification	Daily, before sample analysis	All analytes within ±15% of expected value	Correct problem then repeat initial calibration
	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±15% of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
	Method blank	One per analytical batch	No analytes detected > PQL[f/] in Table 1.2	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	LCS[a/] for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch
	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[b/]
Aromatic Volatile Organics Compounds SW8020A (Cont)	MDL[h/] study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 1.1	Correct problem then reextract and analyze sample
	MS/MSD[i/]	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 1.1	none
	Results reported between MDL and PQL	none	none	none
Methane SW3810 modified	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration
	Second-source calibration verification	Once per five-point initial calibration	All analytes within ±15% of expected value	Correct problem then repeat initial calibration
	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check
	Initial calibration verification	Daily, before sample analysis	All analytes within ±15% of expected value	Correct problem then repeat initial calibration
	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±15% of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
	Method blank	One per analytical batch	No analytes detected > PQLs, in Table 1.2	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[b/]
Methane SW3810 modified (Cont)	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch
	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis
	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 1.1	Correct problem then reextract and analyze sample
	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 1.1	none
	Results reported between MDL and PQL	none	none	none
Volatile Organics SW8260A	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs[j/] average RF ≥ 0.30[k/]; and RSD for all calibration analytes $\leq$ 30%	Correct problem then repeat initial calibration
	Second-source calibration verification	Once per five-point initial calibration	All analytes within ±25% of expected value	Correct problem then repeat initial calibration
	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check
	Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF ≥ 0.30, and CCCs[l/] < 20% drift; and all calibration analytes within ±25% of expected value	Correct problem then repeat initial calibration
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[b/]
Volatile Organics SW8260A (Cont)	Check of mass spectral ion intensities using BFB[m/]	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 1.1)	Retune instrument and verify
	IS[n/]	Immediately after or during data acquisition of calibration check standard	Retention time ±30 seconds: EICP[o/] area within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometer or GC[p/] for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning
	Method blank	One per analytical batch	No analytes detected > PQL, Table 1.2	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch
	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 1.1	Correct problem then reextract and analyze sample
	MS/MSD	One MS/MSD per every 20 project samples per matrix	QC acceptance criteria, Table 1.1	none
	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Results reported between MDL and PQL	none	none	none
Semi-volatile Organics SW8270B	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF ≥ 0.05; and RSD for all calibration analytes ≤ 30%	Correct problem then repeat initial calibration
	Second-source calibration verification	Once per five-point initial calibration	All analytes within ±25% of expected value	Correct problem then repeat initial calibration

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]
Semi-volatile Organics SW8270B (Cont)	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check
	Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF $\geq$ 0.05; and CCCs < 20% drift; and all calibration analytes within ±25% of expected value	Correct problem then repeat initial calibration
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
	Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description	Retune instrument and verify
	IS	Immediately after or during data acquisition of calibration check standard	Retention time ±30 seconds: EICP area within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning
	Method blank	One per analytical batch	No analytes detected > PQL in Table 1.2	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]
Semi-volatile Organics SW8270B (Cont)	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 1.1	Correct problem then reextract and analyze sample
	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 1.1	none
	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Results reported between MDL and PQL	none	none	none
Polynuclear Aromatic Hydrocar-bons SW8310	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration
	Second-source calibration verification	Once per five-point initial calibration	All analytes within ±15% of expected value	Correct problem then repeat initial calibration
	Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check
	Initial calibration verification	Daily, before sample analysis	All analytes within ±15% of expected value	Correct problem then repeat initial calibration
	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±15% of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria

TABLE 7.2 (Continued)

SUMMARY OF CALIBRATION AND QC PROCEDURES

SITE SAMPLING AND ANALYSIS PLAN

RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]
Polynuclear Aromatic Hydrocar-bons SW8310 (Cont)	Method blank	One per analytical batch	No analytes detected > PQL in Table 2.1	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch
	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 1.1	Correct problem then reextract and analyze sample
	MS/MSD	One MS/MSD per every 20 project samples per matrix	QC acceptance criteria, Table 1.1	none
	Confirmation [k/]	100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis
	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Results reported between MDL and PQL	none	none	none
ICP Metals SW6010A	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	Correct problem then repeat initial calibration
	Highest calibration standard	Before beginning a sample run	All analytes within ±5% of expected value	Correct problem then repeat initial calibration
	Calibration blank	After every 10 samples and at end of the analysis sequence	Within ±3 standard deviations of mean blank value	Repeat twice, and average results; if average is not within ±3 standard deviations of background mean, terminate analysis; locate and correct problem; reanalyze previous 10 samples

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]
ICP Metals SW6010A (Cont)	Continuing calibration verification (Instrument Check Standard)	After every 10 samples and at the end of the analysis sequence	All analyte(s) within ±10% of expected value	Repeat calibration and reanalyze all samples since last successful calibration
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
	Method blank	One per analytical batch	No analytes detected > PQL in Table 1.2	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	Interference check solution (ICS)	At the beginning and end of an analytical run or twice during an 8 hour period, whichever is more frequent	Within ±20% of expected value	Terminate analysis; correct problem; reanalyze ICS, reanalyze all affected samples
	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch
	Dilution test	Each new sample matrix	1:4 dilution must agree within ±10% of the original determination	Perform post digestion spike addition
	Post digestion spike addition	When dilution test fails	Recovery within 75-125% of expected results	Correct problem then reanalyze post digestion spike addition
	MS/MSD	One MS/MSD per every 20 project samples per matrix	QC acceptance criteria, Table 1.1	none
	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Results reported between MDL and PQL	none	none	none

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b/]
Lead SW7421	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	Correct problem then repeat initial calibration
	Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within ±10% of expected value	Correct problem then repeat initial calibration
	Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL in Table 1.2	Correct problem then reanalyze calibration blank and all samples associated with blank
	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within ±20% of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 1.1	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria
	Method blank	One per analytical batch	No analytes detected > PQL, Table 1.2	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 1.1	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch
	New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be ±10% of the undiluted sample result	Perform recovery test

I:\IN\CHRI.STON\SAPT73.WW6

TABLE 7.2 (Continued)
SUMMARY OF CALIBRATION AND QC PROCEDURES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION

Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action [b]
Lead SW7421 (Cont)	Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition
	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 1.1	none
	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 1.2	none
	Results reported between MDL and PQL	none	none	none

a/ QC = quality control.
b/ All corrective actions associated with project work will be documented, and all records will be maintained by the laboratory.
c/ RSD = relative standard deviation.
d/ CF = control factor.
e/ RF = response factor.
f/ PQL = practical quantitation limit.
g/ LCS = laboratory control sample.
h/ MDL = method detection limit.
i/ MS/MSD = matrix spike/matrix spike duplicate.
j/ SPCC = system performance check compound.
k/ ≤30% = use a second column or different detector.
l/ CCC = continuing calibration check.
m/ BFB = 4-bromofluorobenzene.
n/ IS = internal standard.
o/ EICP = extracted ion current profile.
p/ GC = gas chromatograph.

TABLE 7.3
REQUIREMENTS FOR CONTAINERS, PRESERVATION TECHNIQUES, SAMPLE VOLUMES, AND HOLDING TIMES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO REMEDIATION

Parameter	Analytical Methods	Container[a/]	Preservation[b/c/]	Minimum Sample Volume or Weight	Maximum Holding Time
Alkalinity	E310.1	P, G	4°C[d/]	50 mL[e/]	14 days
Common Anions	SW9056	P, G	None required	50 mL	28 days for Br^{-}[f/], F^{-}[g/], Cl^{-}[h/] and SO_4^{-2}[i/]; 48 hours for NO_3^{-}[j/], NO_2^{-}[k/] and PO_4^{-3}[l/]
Filterable Residue	E160.1	P, G	4°C	100 mL	7 days
Nonfilterable Residue	E160.2	P, G	4°C	100 mL	7 days
Hydrogen Ion (W[m/], S[n/])	SW9040/ SW9045	P, G	None required	NA[o/]	Analyze immediately
Nitrogen, Nitrate+Nitrite	E353.1	P, G	4°C, H_2SO_4[p/] to pH < 2	500 mL	28 days
Conductance	SW9050	P, G	None required	NA	Analyze immediately
Mercury	SW7470 SW7471	P, G, T	HNO_3[q/] to pH < 2, 4°C	500 mL or 8 ounces	28 days (water and soil)
Metals	SW6010A and SW-846 GFAA[r/] methods	P, G, T	HNO_3 to pH < 2, 4°C	500 mL or 8 ounces	180 days (water and soil)
Semivolatile Organics	SW8270B	G, Teflon-lined cap, T	4°C, 0.008% $Na_2S_2O_3$[s/]	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile Aromatics	SW8020A	G, Teflon-lined septum, T	4°C, HCl[t/] to pH < 2, 0.008% $Na_2S_2O_3$	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Volatile Organics	SW8260A	G, Teflon-lined septum, T	4°C, 0.008% $Na_2S_2O_3$ (HCl to pH < 2 for volatile aromatics by SW8240 and SW8260)	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Polynuclear Aromatic Hydrocarbons (PAHs)	SW8310	G, Teflon-lined cap, T	4°C, store in dark, 0.008% $Na_2S_2O_3$	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)

TABLE 7.3 (Continued)
REQUIREMENTS FOR CONTAINERS, PRESERVATION TECHNIQUES, SAMPLE VOLUMES, AND HOLDING TIMES
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO REMEDIATION

---

[a] Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T).
[b] No pH adjustment for soil.
[c] Preservation with 0.008 percent $Na_2S_2O_3$ is only required when residual chlorine is present.

[d] °C =	Degrees Celsius
[e] mL =	Milliliter
[f] Br^- =	Bromide
[g] F^- =	Fluoride
[h] Cl =	Chloride
[i] SO_4 =	Sulfate
[j] NO_3 =	Nitrate
[k] NO_2 =	Nitrite
[l] PO_4 =	Phosphate
[m] W =	Water
[n] S =	Soil
[o] NA =	Not applicable
[p] H_2SO_4 =	Sulfuric acid
[q] HNO_3 =	Nitric acid
[r] GFAA =	Graphite Furnace Atomic Absorption
[s] $Na_2S_2O_3$ =	Sodium thiosulfate
[t] HCI =	Hydrochloric acid

or equal to the PRL (Table 7.1). Exceptions are not made for common laboratory contaminants. If the blank contaminant concentration is not less than the specified limit, then the source of contamination will be identified, and corrective action will be taken. SQLs and detection limits will not be raised because of blank contamination. Analytical data will not be corrected for presence of analytes in blanks.

7.2.4 Laboratory Control Samples

Laboratory control samples (LCSs) are blank spikes made from clean laboratory-simulated matrices (reference method blank matrices) spiked with known concentrations of all target analytes of interest at levels approximately 10 times the MDLs. The LCS is carried through the complete sample preparation and analysis procedures. LCSs are designed to check the instrument and method accuracy. An LCS will be analyzed with every analytical batch. Failure of the LCS to meet %R criteria listed in Table 1.1 requires corrective action before any further analyses can continue. All sample results associated with the out-of-control LCS must be reanalyzed after control has been reestablished.

7.2.5 Surrogate Spike Analyses

Surrogate spike analyses are used to determine the efficiency of analyte recovery in sample preparation and analysis in relation to sample matrix. Calculated %R of the spike is used to measure the accuracy of the analytical method for an individual sample. A surrogate spike is prepared by adding to an environmental sample (before extraction) a known concentration of a compound similar in type to the target analytes (i.e., a surrogate compound) to be analyzed for organic target compounds. Surrogate compounds as specified in the methods will be added to all samples analyzed, including method blanks, MS/MSDs, LCSs, field samples, and duplicate samples.

7.2.6 Matrix Spike/Matrix Spike Duplicate

Matrix spike (MS) samples are designed to check the accuracy of the analytical procedures for the sample matrix by analyzing a field sample spiked in the laboratory with a known standard solution containing all the target analytes. A matrix spike duplicate (MSD) is the second of a pair of laboratory MS samples. The MSDs are designed to check the precision and accuracy of analytical procedures by sample matrix.

One MS/MSD pair will be collected for every group of 20 project samples of similar matrix. Field blanks or duplicates are not to be used as MS/MSDs. If surrogate and target analyte compounds concentrations are out of control in the MS/MSD, but the associated accuracy and precision are in control in the LCS, then the out-of-control situation will be attributed to a matrix interference. If the laboratory system is shown to be out-of-control (i.e., if the LCS is out-of-control), then re-extraction and reanalysis will be required. The laboratory will report the data from any reanalysis that is performed.

7.2.7 Analytical Batches

Analytical batches will be designated in the laboratory at a minimum of one batch per sample delivery group (SDG). Each SDG will be comprised of a maximum of 20 project samples of similar matrix collected within a 7-day period. Included in each SDG of 20 (or fewer) samples per analytical method will be an analytical batch identification number. This identification number will clearly allow a reviewer to determine the association between field samples and QC samples. Analytical batches also will be inclusive of preparation lots and calibration periods.

7.2.8 Retention Times

Retention time (RT) is the amount of time required for a target compound to elute from the chromatographic column, and the instrument detector to record a signal response. The RT window is the allowable deviation from the true expected RT for any one compound. A peak response within this RT window will constitute a positive detection for that compound. RT windows are QC criteria for all gas chromatograph (GC) and high-performance liquid chromatography (HPLC) methods. RT windows are determined through replicate analyses of a standard over multiple days. The calculation of RT windows is described in USEPA (1995) Method SW8000A. Corrective action is required when the RT windows are out of control.

7.2.9 Internal Standards

Internal standards (ISs) are compounds of known concentrations used to quantitate the concentrations of target detections in field and QC samples. ISs are added to all samples after sample extraction or preparation. Because of this, ISs provide for the accurate quantitation of target detections by allowing for the effects of sample loss through extraction, purging, and/or matrix effects. ISs are used for any method requiring an IS calibration. Corrective action is required when ISs are out of control.

7.2.10 Interference Check Standard

The interference check standard (ICS) is used to verify the background and interelement correction factors for metals in method SW6010A. The ICS is analyzed at the beginning and end of each analytical sequence. Method-specific acceptance limits listed in Table 1.1 will apply.

7.2.11 Second Column Confirmation

Quantitative confirmation of results at or above the PQL for samples analyzed by GC or HPLC will be required and will be completed within the method-required holding times. For GC methods, a second column is used for confirmation. For HPLC methods, a second column or a different detector is used. The result of the first column/detector will be the result reported.

7.2.12 Control Limits

The control limits associated with all method QC will follow guidance established in the AFCEE (1996) QAPP. For methods not defined in the AFCEE (1996) QAPP (e.g., SW3810 modified for methane), the acceptance criterion in Table 1.1 is listed as suggested guidance.

7.2.13 Calibration Requirements

Analytical instruments will be calibrated in accordance with the analytical methods. All analytes reported will be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified in Table 1.1. Records of standard preparation and instrument calibration will be maintained by the contract laboratory. Records will unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards will be traceable to standard materials.

Analyte concentrations are determined with either calibration curves or response factors (RFs). For GC and GC/mass spectroscopy (MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five-point calibration will be used. The continuing calibration will not be used to update the RFs from the initial five-point calibration.

7.2.14 Standard Materials

Standard materials used in calibration and to prepare samples will be traceable to National Institute of Standards and Technology (NIST), USEPA, American Association of Laboratory Accreditation (A2LA) or other equivalent approved source, if available. The standard materials will be current, in accordance with the following expiration policy: The expiration dates for ampulated solutions will not exceed the manufacturer's expiration date or one year from the date of receipt, whichever occurs first. Expiration dates for laboratory-prepared stock and diluted standards will be no later than the expiration date of the stock solution or material, or the date calculated from the holding time allowed by the applicable analytical method, whichever occurs first. The laboratory will label standard and QC materials with expiration dates.

7.3 SAMPLE CUSTODY REQUIREMENTS

Sample custody begins in the field at the time of collection and continues throughout the laboratory analytical process. COC forms will be prepared at the time sample collection and will accompany the samples through the laboratory sample processing. To facilitate the documentation of sample custody, the laboratory will track the progress of sample preparation, analysis, and report preparation. Samples received by the laboratory will be checked carefully for label identification, COC forms, and any discrepancies. The laboratory will also note physical damage, incomplete sample labels, incomplete paperwork, discrepancies between sample labels and paperwork, broken or leaking containers, and inappropriate caps or bottles. On the day of receipt of samples from the contractor, the laboratory will send signed facsimile copies of all COCs and sample log-in receipt forms to the contractor. All discrepancies and/or

potential problems (e.g., lack of sample volume) will be discussed immediately with the contractor's project task manager.

The laboratory sample custodian will be required to provide a report to the contractor of any problems observed with any of the samples received. This report will also document the condition of samples, sample numbers received, corresponding laboratory numbers, and the estimated date for completion of analysis. The laboratory must receive written permission from the contractor before sending any samples (originally scheduled to be analyzed at their facility) to another laboratory. Analyses will not be performed on samples whose integrity has been compromised or is suspect.

7.4 SAMPLE HANDLING

Laboratory sample custody will be maintained by the following procedures:

1. The laboratory will designate a sample custodian responsible for maintaining custody of the samples and all associated paperwork documenting that custody.
2. Upon receipt of the samples, the sample custodian will sign the original COC form and compare the analyses requested thereon with the label on each sample container.
3. A qualitative assessment of each sample container will be performed to note any anomalies such as broken or leaking bottles or lack of preservation (e.g., ice melted enroute). This assessment will be recorded as part of the incoming COC procedure.
4. If the COC and samples correlate, and there has been no tampering with the custody seals, the "received by laboratory" box on the COC form will be signed and dated.
5. Care will be exercised to document any labeling or descriptive errors. In the event of discrepancies, breakage, or conditions that could compromise the validity of analyses, the laboratory project coordinator will immediately contact the task manager as part of the corrective action process.
6. Samples will be logged into the laboratory management computer system, which includes a tracking system for extraction and analysis dates. The laboratory will assign a laboratory work number to each sample for identification purposes. The sample custodian will log the laboratory work number and the field sample identification into a laboratory sample custody log. The laboratory sample custody log may either be hard copy or computerized, depending on the laboratory's system.
7. The samples will be stored in a secured area at a temperature of approximately 4 ± 2 degrees Celsius (°C) or cooler (as applicable) until analyses commence. The laboratory log should also contain the laboratory storage cooler number (if applicable) that the sample will be stored in while on the laboratory's premises. Samples will be logged when they are removed and returned from storage for

analysis. Samples must be stored in separate coolers from those used to store analytical standards, reagents, and/or QC samples.

8. The samples will be distributed to the appropriate analysts, with names of individuals who receive samples recorded in internal laboratory records.
9. The original COC form will accompany the laboratory report submittal and will become a permanent part of the project records.
10. Data generated from the analysis of samples also must be kept under proper custody by the laboratory.

Upon analysis, a laboratory lot control number will be assigned to the sample. All samples within a given laboratory analysis group (e.g., samples sharing the same laboratory QC measurement samples) will have identical laboratory lot control numbers.

Disposal of sample containers and remaining sample material will be the responsibility of the laboratory. Samples should be disposed of appropriately when all analyses and related QA/QC work are completed.

7.5 SAMPLE IDENTIFICATION AND SAMPLE CUSTODY RECORDS

The laboratory conducting the analysis of the samples will provide the data user with information on the laboratory sample identification system. With knowledge of this laboratory sample identification system, data generated at the laboratory can be tracked by both the laboratory and field sample identification systems.

Each sample will be logged into the laboratory system by assigning it a unique sample number. This laboratory number and the field sample identification number will be recorded on the laboratory report.

7.6 LABORATORY DATA REDUCTION, VALIDATION, AND REPORTING

7.6.1 Review Procedures for Definitive Data

The fixed-base laboratory will review 100 percent of all definitive data prior to reporting. The establishment of detection and control limits will be verified. Any control limits outside of the acceptable ranges specified in the analytical methods will be identified. Any trends or problems with the data will be evaluated. Any laboratory-established detection limits that exceed the established method-specified limits will be identified. The absence of records supporting the establishment of control criteria or detection limits will be noted. Analytical batch QC, calibration check samples, method calibrations, continuing calibration verifications, corrective action reports, the results of reanalysis, sample holding times, sample preservations, and any resampling and analysis all will be evaluated.

Samples associated with out-of-control QC data will be identified in the data package case narrative, and an assessment of the utility of such analytical results will be made. The check of laboratory data completeness will ensure that:

- All samples and analyses specified in the SAP have been processed;
- Complete records exist for each analysis and the associated QC samples; and
- Procedures specified in this SAP have been implemented.

The results of the completeness check will be documented.

An analyst other than the original data processor, will be responsible for reviewing all steps of the data processing. All input parameters, calibrations, and transcriptions will be checked. All manually input, computer-processed data will be checked. Each page of checked data will be signed and dated by the verifier.

QC sample results (LCSs, MS/MSDs, surrogates, initial calibration standards, and continuing calibration standards) are compared against stated criteria for accuracy and precision (Table 7.2). QC data must meet acceptance levels prior to processing the analytical data. If QC standards are not met, the cause will be determined. If the cause can be corrected without affecting the integrity of the analytical data, processing of the data will proceed. If the resolution jeopardizes the integrity of the data, reanalysis will occur.

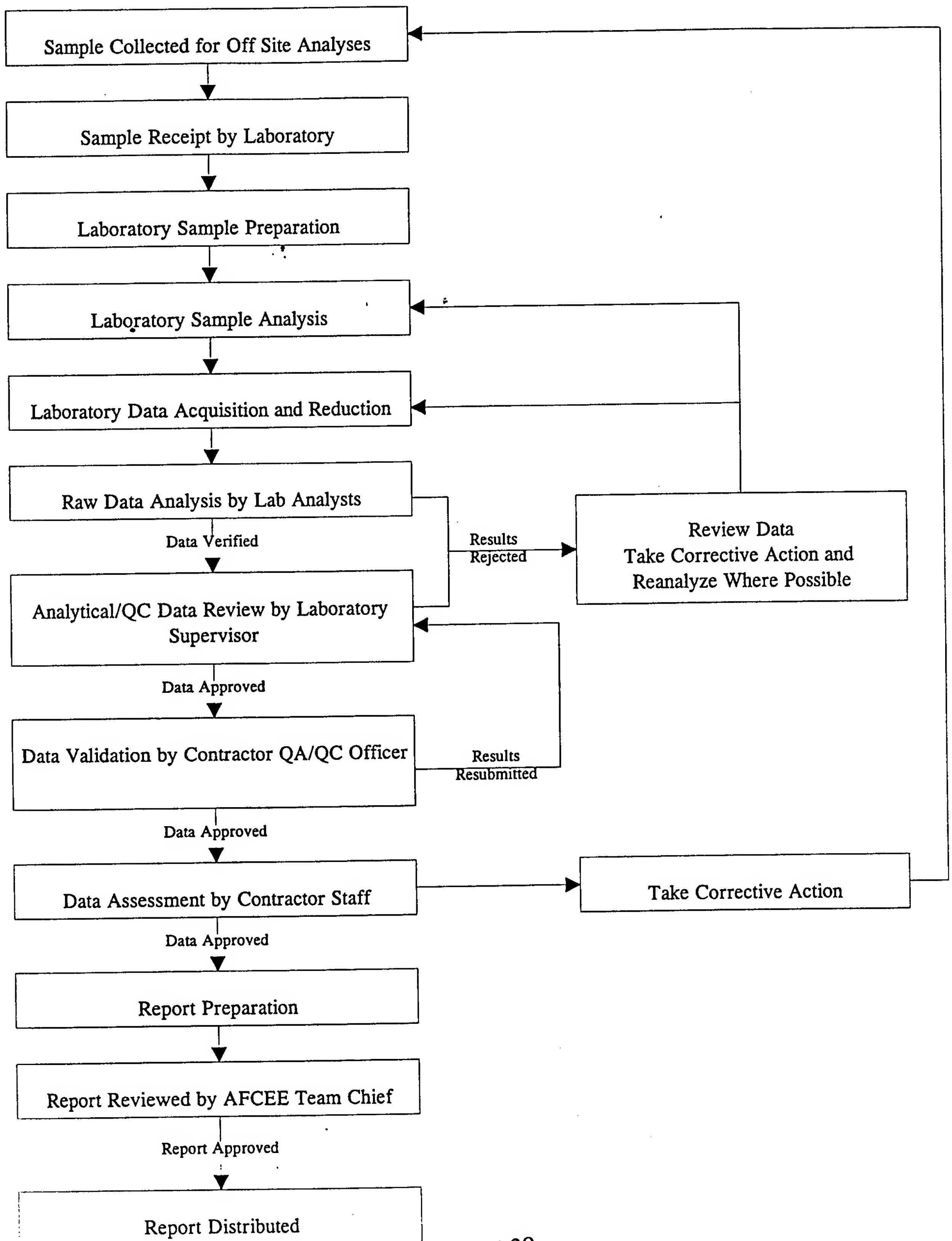
Decisions to repeat sample collection and analyses may be made by the contractor project manager based on the extent of the deficiencies and their importance in the overall context of the project. Figure 7.1 defines the general flow of sample data from sample shipment to the laboratory to the final report generation by the contractor.

7.6.2 Laboratory Data Reporting Flags

The following qualifiers must be used by the laboratory when reporting sample results.

Qualifier	Description
J	The analyte was positively identified, the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL.
F	The analyte was positively identified but the associated numerical value is below the PQL.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
T	Tentatively identified compound (using GC/MS)

FIGURE 7.1
DATA FLOWCHART
QUALITY ASSURANCE PROGRAM PLAN
SITE SAMPLING AND ANALYSIS PLAN
RISK-BASED APPROACH TO FUEL SPILL REMEDIATION



I:\IN\CHRLSTON\SAPF11.AF2

7.6.3 Contractor Data Reporting Flags

The following define the contractor organic and inorganic data validation qualifiers:

- U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is the PRL (e.g., the nondetect level).
- J - The associated value is an estimated quantity.
- R - The data are unusable (Note: analyte may or may not be present).
- UJ - The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

7.6.4 Data Validation and Assessment of Usability

Data from QC samples will be assessed by the contractor using the procedures and criteria presented earlier in this section. This assessment will be a continuous process in which QA problems are identified immediately, and the appropriate corrective action is implemented. Additionally, the contractor will assess the usability of analytical data. Any limitations on data use will be expressed quantitatively to the extent practicable and will be documented in any reporting of the data.

This data usability review will include a review of the analytical methods, quantitation limits, and other factors important in determining the precision, accuracy, completeness, and representativeness of the final data set. The outcome of this data review will be a data set appropriate to support quantitative fate and transport analyses and risk analysis. The data evaluation methods defined in *Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual* (USEPA, 1989) and the *Guidance for Data Useability in Risk Assessment* (USEPA, 1992) will be used as appropriate.

7.6.5 Hard-Copy Data Deliverables

Data deliverables required for the analytical results include both a hard copy and an electronic copy. Hard-copy reporting of analytical results will include analytical results summaries for all field samples, and their associated QA/QC samples. The laboratory will be required to provide two copies of each hard copy data reporting package. Data reporting requirements for hard-copy analytical reports are in Table 7.4 as those items listed with an asterisk.

7.6.6 Electronic Data Deliverables

To facilitate data handling and management, both field and laboratory data will be entered into a computerized format. All data will be delivered to the contractor from the laboratory in the database format specified in the *Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook*, Version 2.2, AFCEE, 1991. The laboratory will be responsible for running QC Tools on the analytical data files prior to delivery to the contractor.

TABLE 7.4
REQUIRED LABORATORY DELIVERABLES

Method Requirements	Laboratory Deliverables (Definitive Data)
Requirements for all methods:	
- Case narrative	Project identification Analytical method description and reference citation. Discussion of unusual circumstances, problems, and nonconformances.
Monthly QA report	Any format to discuss issues which may affect data quality *
- Chain of Custody (COC)	Signed and dated when samples were* received at laboratory
- Dates of sample preparation and analysis (including first run and subsequent runs).	Specific deliverable depends upon* type of analysis
- Quantitation limits achieved.	Specific deliverable depends upon type* of analysis
- Dilution or concentration factors.	Specific deliverable depends upon* type of analysis
- Summary analytical batch report including analytical batch samples, method of analysis, matrix description, date of sample collection and receipt, laboratory identification number of each environmental sample plus identification number of each batch quality control (QC) sample (including Matrix Spike/Matrix Spike Duplicate (MS/MSD), calibration check, etc.).	Any format*
- Method reporting limits.	QC summary report*
- QC limits.	QC summary report*
- Practical Quantitation Limit (PQL) verification standard (weekly).	Any format
- Corrective action reports.	Any format *
- A copy of all raw laboratory analytical data.	Any format (chromatograms, mass spectra and data system printouts)
- Example sample calculation	Any format
- A copy of the sample preparation data form for each method indicating sample identification number, batch identification number, and date of preparation.	Any format (preparation, extraction, or digestion data)
Percent moisture for all soil samples	Any format *

TABLE 7.4 (Concluded)
REQUIRED LABORATORY DELIVERABLES

Method Requirements	Laboratory Deliverables (Definitive Data)
Requirements for organic analytical methods:	
- Sample data sheets.	Summary information only [a/]*
- Surrogate recoveries.	Summary information only *
- MS/MSD.	Summary information only *
- Method blank analysis.	Summary information only *
- Laboratory control spike (LCS)	Summary information only*
- Instrument performance check (Tuning).	Summary information only
- Degradation/breakdown (SW8080).	Summary information only
- Initial calibration data	Summary information only
- Continuing calibration data.	Summary information only
- Calibration blank data	Summary information only
- Internal standard area and retention time summary data.	Summary information only
- Retention time windows	Summary information only*
- Second-column confirmation. To be done for all compounds that are detected above reporting limit	Summary information only*
- Analysis run log.	No format
Requirements for inorganic analytical methods Metals:	
- Sample data sheets.	Summary information only *
- Initial and continuing calibration.	Summary information only
- Method blank, taken through sample preparation.	Summary information only *
- Calibration blank data.	Summary information only
- Interference check sample.	Summary information only
- Laboratory control spike/laboratory control spike duplicate.	Summary information only*
- Matrix spike/matrix spike duplicate.	Summary information only *
- Post-digestion spike sample recovery	Summary information only
- Method of standard additions	Summary information only
- Serial dilutions	Summary information only
- Analysis run logs	No format

* Indicates hard-copy deliverables required for QC summary package of Option 3 and 4.

a\ Summarized results can be in any format that provides the necessary data to completely validate that QC parameter. Example formats are the form equivalents to those defined for the USEPA Contract Laboratory Program (CLP) or SW-846 programs.

The laboratory reporting system will be implemented and tested prior to beginning the sampling. Any problems detected in format will be corrected by laboratory prior to providing any electronic deliverables to the contractor. All data entered into the electronic data files will correspond to the data contained in the original laboratory reports and other documents associated with sampling and the laboratory hard copy data deliverable packages.

7.6.7 Quality Assurance Reports

At monthly intervals beginning with the initiation of sampling activities, the laboratory will submit to the contractor's project task manager an internal QA report that documents laboratory-related QA/QC issues. These reports will include discussions of any conditions adverse or potentially adverse to quality, such as:

- Responses to the findings of any internal or external systems or performance laboratory audits;
- Any laboratory or sample conditions which necessitate a departure from the methods or procedures specified in this SAP;
- Any missed holding times or problems with laboratory QC acceptance criteria; and
- The associated corrective actions taken.

Submittal of QA reports will not preclude earlier contractor notification of such problems when timely notice can reduce the loss or potential loss of quality, time, effort, or expense. Appropriate steps will be taken to correct any QA/QC concerns as they are identified. The QA reports and a summary of the laboratory QA/QC program and results will be included in the final project report.

7.7 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to data quality are promptly investigated, evaluated, and corrected. Adverse conditions may include malfunctions, deficiencies, deviations, and errors.

When a significant condition adverse to data quality is noted at the laboratory, the cause of the condition will be determined, and corrective action will be taken to prevent repetition. Condition identification, cause, reference documents, and corrective action planned will be documented and reported to the contractor QA officer by the laboratory QC coordinator. Following implementation of corrective action, the laboratory QC coordinator will report the actions taken and their results to the contractor project manager and QA officer. A record of the action taken and results will be attached to the data report package. If samples are reanalyzed, the assessment procedures will be repeated, and the control limits will be reevaluated to ascertain if corrective actions have been successful.

Implementation of corrective action is verified by documented follow-up action. All project personnel have the responsibility, as part of the normal work duties, to identify, report, and solicit approval of corrective actions for conditions adverse to data quality.

Corrective actions will be initiated in the following instances:

- When predetermined acceptance criteria are not attained (Tables 7.1, 7.2, and 7.3) (objectives for precision, accuracy, and completeness);
- When the prescribed procedure or any data compiled are faulty;
- When equipment or instrumentation is determined to be faulty;
- When the traceability of samples, standards, or analysis results is questionable;
- When QA requirements have been violated;
- When designated approvals have been circumvented;
- As a result of systems or performance audits;
- As a result of regular management assessments;
- As a result of intralaboratory or interlaboratory comparison studies; and
- At any other instance of conditions significantly adverse to quality.

Laboratory project management and staff, such as QA auditors, document and sample control personnel, and laboratory groups, will monitor work performance in the normal course of daily responsibilities.

The laboratory QC coordinator or designated alternate will audit work at the laboratory. Items, activities, or documents ascertained to be compliant with QA requirements will be documented, and corrective actions will be mandated in the audit report. The contractor QA officer and laboratory QC coordinator will log, maintain, and control the audit findings.

The contractor QA officer and laboratory QC coordinators are responsible for documenting all out-of-control events or non-conformance with QA protocols. The QC checks, their frequency, acceptance criteria, and corrective actions for out-of-control data are summarized in Table 1.1 for each analytical method. A nonconformance report will summarize each nonconformance condition. The laboratory will notify the contractor project manager or QA officer of any laboratory QA/QC nonconformances upon their discovery. Copies of all field change requests and corrective action forms will be maintained in the project files. A stop-work order may be initiated by the contractor if corrective actions are insufficient.

7.7 AUDITS

This section describes participation in external and internal systems audits for AFCEE contractors and laboratories.

7.7.1 System Audits

System audits review laboratory operations and the resulting documentation. An onsite audit ensures that the laboratory has all the personnel, equipment, and internal standard operating procedures (SOPs) needed for performance of contract requirements in place and operating. The system audits ensure that proper analysis documentation procedures are followed, that routine laboratory QC samples are analyzed, and that any nonconformances are identified and resolved.

7.7.2 Internal Audits

The laboratory must conduct internal system audits on a periodic basis. The results of these audits will be documented by the laboratory QC coordinator, and the laboratory will provide the contractor with the results of these internal audits.

7.7.3 External Audits

The contractor project QA officer or designee may conduct an external system audit of the laboratory during the performance project samples. This audit would evaluate the capabilities and performance of laboratory personnel, items, and activities. It also documents the measurement systems and identifies and corrects any deficiencies. The contractor QA manager acts on audit results by documenting deficiencies and informing the contractor project manager of the need for corrective action. The contractor project manager may suspend operations until problems are resolved. If conditions adverse to quality are detected, or if the contractor project manager requests additional audits, additional unscheduled audits may be performed.

In addition to the contractor audit of the laboratory, various state and/or federal agencies may conduct an audit prior to the commencement of the project, and may conduct additional audits as deemed necessary. The frequency and schedule of any such audits will be established by the auditing agency and coordinated directly with the laboratory.

7.7.4 Performance Audits

Laboratory performance audits may be conducted to determine the accuracy and implementation of the SAP by the contractor QA manager or designee prior to initiation of field sampling. Unplanned audits may be implemented if requested by the contractor project manager. In addition to in-house performance audits, the laboratory may also participate in interlaboratory performance evaluation studies for different state or federal agencies. The contractor project QA manager will act to correct any laboratory performance problems.

7.8 PREVENTIVE MAINTENANCE

7.8.1 Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturers' specified recommendations or written procedures developed by the operators.

7.8.2 Schedules

Manufacturers' procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the individual operator assigned to a specific instrument to adhere to the instrument maintenance schedule and to promptly arrange any necessary service. Servicing of the equipment, instruments, tools, gauges, and other items will be performed by qualified personnel.

The laboratory will establish logs to record maintenance and service procedures and schedules. All maintenance records will be documented and will be traceable to the specific equipment, instruments, tools, and gauges. Records produced for laboratory instruments will be reviewed, maintained, and filed by the operators at the laboratories.

7.8.3 Spare Parts

A list of critical spare parts will be requested from manufacturers and identified by the operator. These spare parts will be stored for availability and use in order to reduce downtime due to equipment failure and repair.

7.9 SUBCONTRACT LABORATORY SERVICES

The laboratory will assume responsibility for providing all analytical services specified in the laboratory agreement. Should it be agreed in writing that the laboratory may use an additional subcontract laboratory facility, the primary laboratory will supply to the contractor the SOPs, MDL studies, and QA plans for the other laboratories that are used. The laboratory will be responsible for communicating all analytical guidelines and QC requirements of the project to these laboratories. The QA officers from both the primary laboratory and the contractor will monitor the data from subcontract laboratories and correct any QC nonconformances.

SECTION 8

REFERENCES

Air Force Center For Environmental Excellence (AFCEE) 1991, *Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook,* Version 2.2.

AFCEE 1996, *Quality Assurance Project Plan, Version 1.1.* February.

American Society for Testing and Materials (ASTM) 1987, *American Society for Testing and Materials Methods.*

Barcelona, *et. al.*, 1994. *Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling.* January.

Downey, D.C., and Hall, J. F. 1994. *Addendum One to Test Plan and Technical Protocol for a Field Treatability Test for Bioventing - Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential.* Prepared for the Air Force Center for Environmental Excellence, Brooks Air Force Base, San Antonio, Texas.

Parsons Engineering Science, Inc. 1996. *Draft Corrective Action Plan for the Risk-Based Remediation of the MOGAS site.* Prepared for the Air Force Center for Environmental Excellence, Brooks Air Force Base, Texas and Myrtle Beach Air Force Base, South Carolina, June.

United States Environmental Protection Agency (USEPA), 40 CFR 136, (Section 7.0, "Internal Quality Control Checks,"). *Guidelines Establishing Test Procedures for the Analyses of Pollutants,* Appendix III, "Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants".

USEPA, 1983, *Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-79-020 .

USEPA, 1989, *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual* (Part A).

USEPA, 1992. *Guidance for Data Useability in Risk Assessment.*

USEPA, 1993. *Data Quality Objectives Process for Superfund.*

USEPA, 1995. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846,* (3rd Edition, Update IIB).